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The Chicago Drainage Board has notified all its contractors to begin active operations at as many points as possible on their work on or before Sept. 1. They are to execute all river diversions and levee building required to fully protect their works as rapidly as possible, so as to avoid any risks or delay in the subsequent progress of the work. The engineering staff is to make surveys at once for the Chicago River end of the big ditch in order that any further bridges or other permanent structures built upon it may be designed to conform to the permanent plan. Authority has been granted to Chief Engineer Williams to make a thorough investigation of the recent flood in the Illinois valley and also the flood volumes of the upper Des Plaines and Calumet rivers. The total number of permanent employees in the engineering department, according to the list submitted by the Chief Engineer and approved by the Board, will be 91, divided as follows: Heads of divisions, 4; assistant engineers, 8; subassistant engineers, 9; instrument men, 6; recorders, 13; draftsmen, 13; computers, 3; rodmen, 7; flagmen, chainmen, axemen and laborers, 25; office helpers, 3.

Contracts were closed with Mason, Hoge & Co. for Section 13 and with Agnew & Co. for Sections 8 and 9.

The Mississippi River Commission, which has been holding public sessions in New York City during the week just passed, has sent the following recommendations to the Secretary of War:

(1) That of the $10,000,000 placed at their disposal for the next four years, $6,000,000 be devoted to the building and strengthening of levees on the Mississippi River—said money to be expended at the rate of $1,500,000 a year for the next four years, ending with 1895. (2) That $4,000,000 be appropriated for chaneling purposes, said sum to be expended at the rate of $1,000,000 a year for the next four years.

A tunnel under the ship canal at Duluth, Minn., is projected, and a report on the project has been made to the Board of Public Works, by Donald Dennes, an English engineer, whose present residence is given as Rapid City, S. Dak. He proposes two steel tubular tunnels side by side, 21 ft. in diameter inside. Each tunnel will have an outer tube 25 ft. in diameter, built of ⅝-in. steel plates. The space between the two tubes will be filled with concrete. The top of the tubes is to be 23 ft. below the bottom of the canal. The approaches will have a 2% grade, making each of them 1,500 ft. in length, and the total length of the tunnel 3,250 ft., the canal being 250 ft. wide. The approaches will be built in the same manner as the tunnel under the river, except that the outer steel tube will be only 23 ft. in diameter. The estimate of material is: Steel, 18,228,914 lbs.; excavating, 351,481 cu. yds.; Dredging, 2,129 cu. yds.; cement, 3,630 tons.

For the above particulars we are indebted to Duluth's two daily papers, but as the accounts in the two agree in very few particulars, we will not answer for the accuracy of the statements above, and can only claim for them, that they are as near the facts as we can come, from these sources of information. Both papers agree that the engineers' estimate of cost is $706,669.70, but one declares that this sum is the total cost, while the other says that it is for the portion under the river only, and estimates that the approaches will cost as much more. This doubtless looks reasonable to the editor, since if 250 lin. ft. of tunnel cost the sum stated above, 3,000 lin. ft. of approaches, built on substantially the same plan, would naturally cost at least as much more. We hope to give our readers more trustworthy information in later issues.

The contract for three new Atlantic greyhounds for the Inman line is reported let to Wm. Cramp & Sons. The law granting American registry to the "City of New York" and "City of Paris" of the Inman line, obliged the company to build an equal tonnage of new vessels in this country.

An enormous electric search light is being erected on the summit of Mt. Washington by Louis H. Rogers, of Boston.

Natural gas is getting so scarce in Ohio that pumps are being erected to force the gas through the mains and are expected also to exert a suction which will increase the flow from the wells. At Bairstown, a few miles west of Fostoria, a pumping plant with a capacity of 13,000,000 cu. ft. of air daily is being erected by the Northwestern Ohio Natural Gas Co. The contrast is a striking one between this state of affairs and that of two or three years ago, when the wells were first drilled and nearly everyone was pouring forth a flow under great pressure, equal to, or greater than the capacity of this set of pumps.

The most serious railway accident of the week was the collision of a passenger train with a wrecked freight train at Harbor Creek, Pa., on the Lake Shore & Michigan Southern Ry., Aug. 5. The freight was switching onto the sidetrack to let the passenger train pass, when it was run into by a following freight train, several cars being wrecked and thrown across the main track. Almost at the same time the passenger train came up. The engineman and fireman of the passenger train and two passengers were killed. The coroner's jury found that the train dispatcher at Buffalo, was guilty of gross negligence and disobedience of orders in not advising the crew of the second freight train of the movements of the first train, and deserved severe censure; also that the engineman of the second train was guilty of carelessness and neglect of duty in not keeping a proper lookout for danger ahead. The jury censured the railway officials for allowing their subordinates to disregard the imperative rule requiring a copy of orders governing the train ahead to be given to the train immediately following.—A serious rear collision occurred at West Brooklyn, N. Y., on the Brooklyn, Bath & West End R. R., Aug. 7. Coney Island trains from the union station and the Thirty-ninth St. station are made up into one train at the West Brooklyn junction, one section stopping on the track and the engine of the following section making a flying switch. Only one brakeman applied the hand brakes on his own car, and this was not sufficient to check the five heavily loaded cars, which ran into the front section, smashing the platforms, and the shock tore some of the seats up and threw people to the floor, and threw some from the open cars to the ground. Nine persons were seriously injured and a large number badly bruised. This is a dangerous system of operation, but the Coney Island roads, with their heavy traffic, are not handled very carefully. There have been three or four accidents in about a week, and we commented upon one of these in our issue of July 21.

Railway accidents in New Jersey during 1891, according to the State Controller's annual report, amounted to 1,500 on the 4,146 miles of railway in the state. By them 331 persons were killed and 1,229 injured. Of these 204 were killed or injured by jumping from moving trains. The coupling of cars and track walking are shown to have been the most prolific causes of injury or death.

A pumping plant for natural gas is to be established at Bairdstown, O., in consequence of the failure of pressure. The plant will be put in by the Northwestern Ohio Natural Gas Co., and will have a capacity of 13,000,000 cu. ft. per 24 hours. The pumps will draw the gas from the wells, traps being used to catch the salt water which comes from the rock under suction, and will force it through mains to Toledo, Detroit, etc. There will be two sets of pumps.

A natural gas well with a flow of 1,000,000 cu. ft. per day is reported near Birdstown, Pickett Co., Tenn.

A flood in St. Paul, Minn., on the night of Aug. 3 wrecked six buildings and caused the death of three people. A street embankment had been carried across a deep ravine, forming an earth dam about 35 ft. high, 200 ft. long, 60 ft. wide on top and about 165 ft. wide at the base. A box drain 3 ft. high and 2 ft. wide was built in the base of the fill and, as only surface water flowed in the ravine, was supposed to be sufficient. Boys living in the neighborhood are said to have stopped up the drain to make a skating pond last winter, but as the quantity of water was small no attention was paid to it. Recent heavy rains increased the water until it formed a lake, covering four acres, according to one account. Workmen were detailed to draw off the water, but before they had done any effective work the water-soaked embankment gave way.

The ocean record for one day's run of 528 miles, recently made by "La Touraine," has just been equaled by the "Teutonic" in her trip ending Aug. 3. The statement has been made that as this is an apparent average speed of 22 knots, and our new commerce destroyer, the "Columbia," has a guaranteed speed somewhat less than this, therefore the latter vessel will not be able to overtake the fastest of the ocean greyhounds. The naval authorities have pointed out, however, that each day's run in the case of the Atlantic liners is customarily measured from midnight to midnight, the time in each place being the correct time for that latitude. Thus the 528 miles run in 24 hours by the ship's time was actually run in 24.93 hours, making the average speed less than that guaranteed for the "Columbia."

No less than 205 models of street car fenders were submitted to the Boston Aldermen recently. A half dozen of the most promising are to be given a thorough test at an early date.

California asphalt deposits are being extensively utilized for street paving in some of the Pacific Coast cities. About 18 miles of San Francisco streets, or over one-sixth of the accepted street mileage of that city, is now paved with bituminous rock; over seven miles of this was laid during the past year. The laying of this pavement in San Francisco begun about six years ago; and Mr. Jas. Gilleran, Superintendent of Streets, says that thus far the cost of its repair has been less than that of any other pavement in use in the city. The first cost of the pavement is about $2.25 per sq. yd.

Permission to build electric subways in Providence, R. I., has been asked of the Board of Aldermen by the Providence Telephone Co.

The Union Pacific R. R. has awarded a contract to Mr. Arthur Pennell, of Kansas City, Mo., to erect, maintain and operate a plant for treating the water at Bitter Creek, Wyo. He guarantees that the water shall be free from scale, corrosive matter or tendency to foam. The Bitter Creek water contains 25.05 grains of sulphate of soda and 48.90 grains of carbonate of soda per U. S. gallon. The plant is to be capable of furnishing water at the rate of 50,000 gallons per 24 hours.

The tower of the Baltimore City College was blown down with dynamite cartridges on Aug. 4 by the contractors for the Baltimore Belt R. R., without injury to the rest of the building. The foundations to the tower settled owing to the construction of the tunnel underneath the street beside it, and as the tower was made unsafe it was necessary to tear it down.

Traffic on the Erie Canal is rapidly decreasing. Of 72,570,000 bushels of grain delivered by lake vessels at Buffalo from the opening of navigation to Aug. 1, only 10,242,000 bushels were shipped to New York by canal. This is only half the traffic which was carried by canal during the same period in 1890. The reason for the falling off is the railway competition, rail rates to New York having been as low as 2½ cts. per bushel.

A rack railway to the Rothhorn near Brienz, Switzerland, was opened for traffic June 16, 1892. This is the highest mountain railway on the European continent, says the "Schweizerische Bauzeitung." The elevation of the terminal station is 1,388.6 ft. above the level of the sea, and the difference of elevation overcome is 5,517 ft. The railway is on the Abt rack rail system It was projected by Mr. A. Lindner, civil engineer, and constructed by Mr. Theo. Bertshinger, Lensburg, Switzerland.

THE DEEP ARTESIAN WELL AT GALVESTON, TEX.

A well more than half a mile, 2,920 ft., deep, which when completed will have a casing its whole length with a 6-in. internal diameter, was recently sunk at Galveston, Tex. The work was done by the Galveston Artesian Well Co., for the city of Galveston. The contract called for a depth of 3,000 ft. if necessary.

Through the kindness of Mr. J. W. Byrnes, of the above company, we are enabled to present a description on the work as it had progressed to June 10, 1892, and also to give two views of the derrick and machinery used in sinking the well, and a section

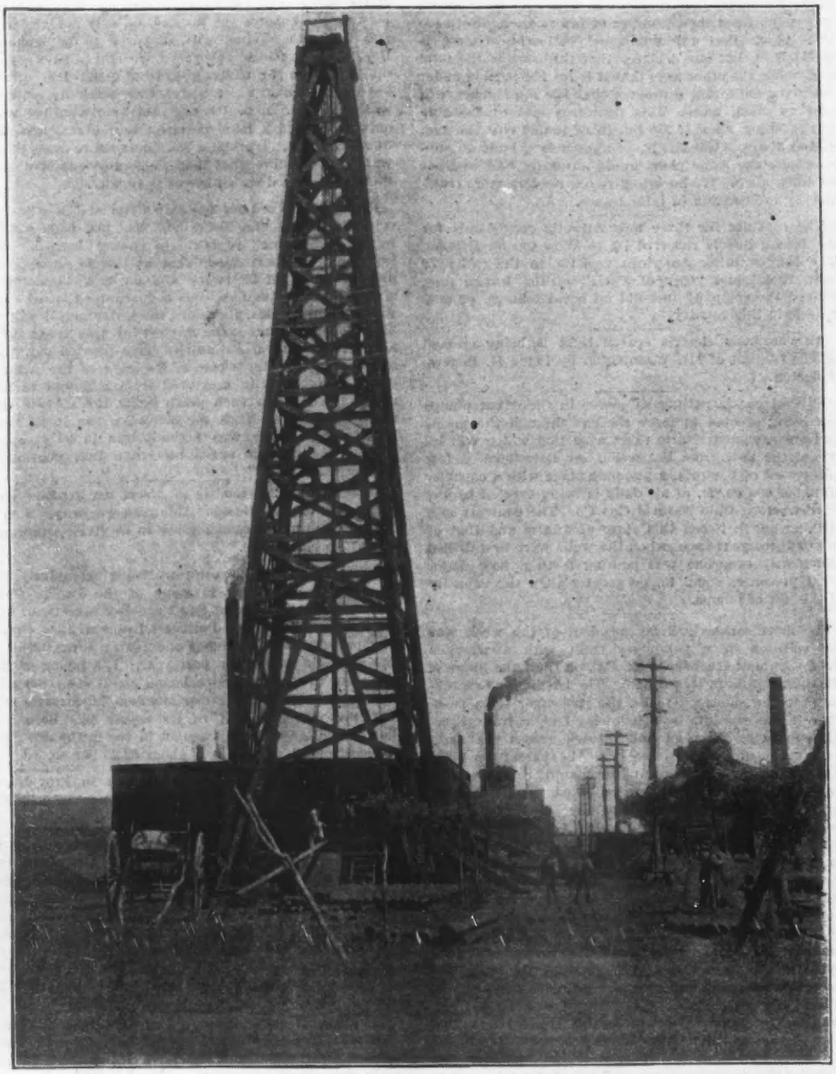


FIG. 1. DERRICK OF THE DEEP ARTESIAN WELL AT GALVESTON, TEX.

showing the strata pierced and the diameters of the successive casings used.

Fig. 1 shows the derrick complete, which is 98 ft. high. Fig. 2 is a nearer view of the lower part of the derrick and machinery. One swivel or water head lies on the ground and the other is suspended in front. Fig. 3 is a section through the well.

Mr. Byrne's description of the well and the way it was sunk is as follows:

The process used was the revolving and jetting as patented by Chapman Bros., of the American Well Works, of Aurora, Ill. A revolving table is used by which the pipe is clamped and revolved while being sunk. A column of water is driven through the pipe under a pressure which forces the borings up the outside of the pipe being revolved. The boring or cutting is done by a shoe or cutter made of 1-in. steel plate in the form of a barrel saw with a bar crossing the diameter of the shoe. This bar has teeth which cut or bore out the core as the pipe passes through clay or other solid material. When passing through sand strata the force of the column of water is sufficient to remove the sand contained within the area of the pipe. The pipe revolves on a swivel head to which the pipe is screwed. In the same head the hose is attached, which prevents the hose revolving with the pipe. The purchase power has to be of sufficient capacity to sustain the pipe regardless of its length or weight. For this work I had constructed a compound, geared power which starts from a 50-HP. duplex engine with a 12×5-in. face gear onto a 48-in. gear on a counter shaft with a 12-in. pinion, 8-in. face, running onto a 72-in. 8-in. face gear on the same shaft. The cable which holds the weight of the pipe is wound onto a shaft which is 10 ins. in diameter and 66 ins. long. The cable passes through five 18-in. sheaves on the top of the derrick, which is 98 ft. high. The cable then passes down through a four-sheave block made of steel plates and 18-in. sheaves with 3-in. steel pins. The weight of this block is 1,360 lbs. This combination of gearing and blocks increases the force exerted by the engine about 140 times, for handling the pipe. I also have on the counter and main shafts two gears of equal diameter which enable me to drive the main shaft at the same speed as the counter shaft, which facilitates hoisting in the pipe when making a coupling or any other work where speed is required at the expense of power.

The well was started with a 22-in. casing with which the surface sand was removed to a depth of 57 ft.

We then went down inside of this casing with 15-in. pipe, which we sunk to the depth of 870 ft. Then we telescoped inside of this pipe with 12-in. pipe, with which we went down to the depth of 1,500 ft. Owing to an accident the pipe parted at a coupling 170 ft. below the surface. We removed the defective couplings and connected up the pipe again, but could not go any farther with the 12-in. pipe. This was the first mishap, as we had calculated to go 2,000 ft. with the 12-in. pipe. I telescoped this time with 9-in. pipe and went down to the depth of 2,363 ft. with this size pipe. I then inserted 200 ft. of 8-in. flush joint pipe inside of the 9-in., and 212 ft. of 7-in. flush joint inside of the 8-in., reaching a depth of 2,600 ft. I then went down with 700 ft. of 4-in. pipe with a 6¾-in. shoe attached to the bottom of the same, coupling onto this 4-in. pipe sufficient 6-in. pipe to reach the surface. With this I bored a hole to the depth of 2,920 ft. At this depth I struck a vein of water-bearing sand in which the water passed away, preventing me from bringing the borings to the surface. Then we pulled this string of pipe up, leaving 320 ft. of uncased hole below the bottom of the 7-in. pipe. We then went down with 486 ft. of 6-in. flush joint pipe, but did not succeed in getting it to the depth of the hole, owing to the friction of sand outside the pipe, as I was jetting the borings or displacements up through the inside of the 6-in. pipe with a 3½-in. pipe sunk through the 6-in. I am now cutting the 6-in. pipe up in short pieces and taking it out with the view of trying to revolve the flush joint 6-in. pipe down to the depth required, although I have but ⅜ in. between the inside diameter of the 7-in. pipe and the outside diameter of the 6-in. flush joint pipe I am going down with. You will see from the cross-sections of the well that the difficulties in getting the pipe down by any other process than that we are using would be almost insurmountable. In ordinary wells of a depth of from 800 to 1,200 ft. I have gone down with this process in from 36 to 60 hours, but the process is hazardous, as any stoppage of the pressure or the flow of water for but a few minutes will cause the sand to cave around the pipe, preventing revolving or forcing open the openings which surround the pipe while revolving.

The photographs of the plant we are now using in sinking the well show the water heads, blocks, tackle, etc. In the rear is machinery, pumps, engine, etc. To the left is the 150-HP. boiler. The entire height of derrick from ground to top is 98 ft. Everything about this plant is built massive and strong, as the weight to be sustained and easily handled in a well of this depth is very great. The water heads are made of bronze and weigh 1,260 lbs. each. The sills of derrick are 12×15 ins., 50 ft. long. The corner columns of the derrick are of 3½ ×15 in. and 12×3½-in. double dressed yellow pine. The girts are 2¼×8 ins., all securely bolted together. The head block is made of four steel plates 1×12 ins., 5 ft. long, outside of which are two 12×15-in. pine sticks all securely bolted together. There are five sheaves 18 ins. in diameter, 2½-in. groove, with 3-in. steel pins. The head blocks and derrick will safely sustain 300 tons; the greatest weight to which they would be subjected is 90 tons.

The contract price of this well is $75,000 completed to 3,000 ft., finished with 6-in. pipe if suitable water is not found at a lesser depth. If accepted by the city at any depth under 3,000 ft. we are to receive $25 per foot to that depth. The cost of plant when ready to commence work was a little less than $12,000.

The water pressure is obtained from three pumps with a combined capacity of 1,500,000 gallons per day and capable of furnishing a pressure of 250 lbs. per sq. in.

The following particulars have been furnished us by the American Well Works. Fig. 4 represents the machinery which sinks the well, combined in one machine. The engines made for Mr. Byrnes were the company's oil-well pattern, two of them connected together, with steam cylinders 10×12 ins. The pumps are shown, but not the engines, and in the center of the cut is shown the hoisting gear. The worm and hand wheel regulate the descent of the tube as the material is cut away by the rotary machine at the right. The revolving hydraulic jetting rig has an elliptical rock drilling motion, which lifts the drill slowly to economize power and drops

it with great speed, striking a powerful blow that cuts the rock rapidly. An enlarged view of the reversible rotary machine is shown in Fig. 5. This is a Chapman machine which bores the hole, sinks the tube and completes the well at one operation. In the upper part of the cut a swivel is shown to which the rope is connected which supports the weight of the tube. The machine which rotates the tube grips it to turn it, but the grips being loose on their axes, allow the pipe to have a firm downward movement when firmly gripped. It has reverse gearing so that in case anything catches in the cutter on the bottom of the tube the gears are reversed, which disengages the obstruction, and then are thrown forward again. The cutter that is used on the bottom of the pipe is shown in Fig. 6. Fig. 7 shows a section of the

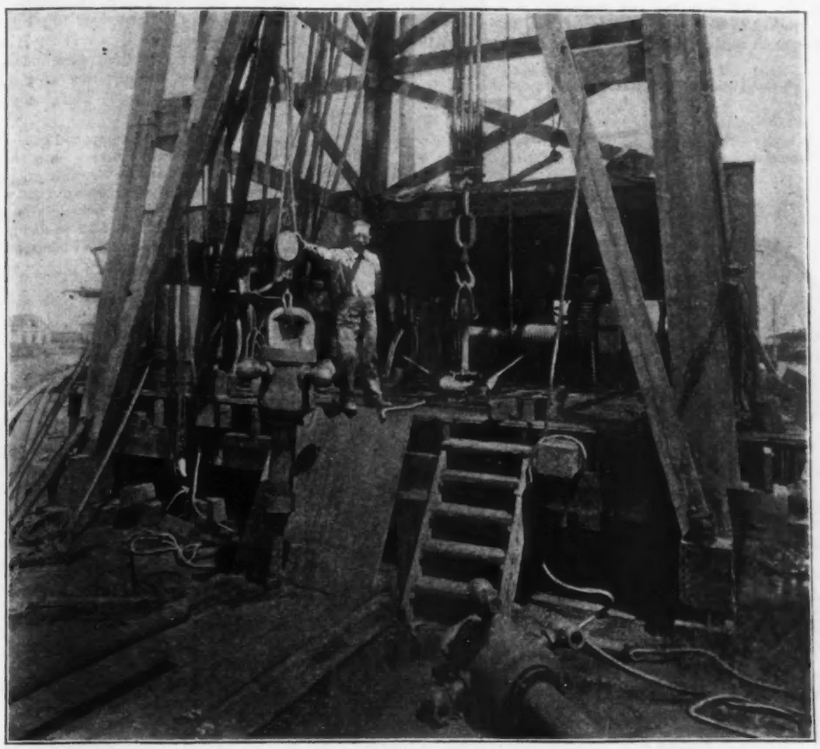


FIG. 2. WELL-DRILLING PLANT FOR THE DEEP ARTESIAN WELL AT GALVESTON, TEX.

materials penetrated in the deep alluvial soils on the coast of the Gulf of Mexico, and represents very nearly the character of the ground that Mr. Byrnes has to penetrate. The derrick used is the ordinary plan of derrick, and should be about 60 ft. high, adjustably opened on one side so that from 40 to 60 ft. of pipe can be erected in the derrick, after being connected together on the ground in one string. Fig. 8 shows the lower section of the tube, but has the well strainer which is connected to the bottom of the tube, and when water is reached it will be known. This section is connected to the bottom end of the pipe to be sunk, which is settled by rotation or oscillation, having a gyrating reversible motion. The strainer pipe is perforated, and for sand it is covered with the filtering surfaces. In sinking a well the water is forced down through the pipe O, and would pass out through the upper end of the perforations of the pipe but for the pipe N, which conducts the water past the opening in this strainer. On the top end there is a valve covering a valve seat, which prevents the water passing by it. Hence, it has to pass down the tube N, as indicated by the arrows 1. On the bottom end of the tube N there is a valve that opens downward by the force of the water going down. This allows the water to pass out and carry away the cuttings that are made by the cutters J, on the shoe H, then the water will pass up on the outside of the strainer O, and well pipe, as shown by arrow 1, going to the top of the ground, carrying away the mud and debris, keeping the hole clear as the well is sunk. Every length of pipe that is added on the top (the pipe being open) will show whether there is water below; if there is water, then it will pass through the strainer, as shown by the arrows marked A, and pass up through the valve that is on the top of the tube N, and show itself. When water has been reached and does not flow over the top, then a pump can be put in. When water is reached the valve on the bottom of the tube N will close, and the valve on the top will open. The cutters J on the bottom are not of the same length. When the cobble stones are reached the longer cutter will strike first and catch on the stone, causing it to gyrate from the true center and will allow the cutter to pass; the water forced down will also cause the stone to be moved aside, which would not be done if the cutters were the same length. The teeth of the shoe are eccentrically placed so that a clearance is made for the water and debris to pass out freely.

A brief description of the sinking of the well by this process is as follows: A derrick is erected high enough to have from 40 to 60 ft. of pipe raised in the derrick in one string, and the machinery, Fig. 4, is set in the derrick. A boring tool, Fig. 6, is screwed to the lower end of the tubing that is to form the wall of the well. A swivel is connected to the upper end of the tube and can set in to the machine, as shown in Fig. 5. A hose is connected to the swivel which conducts water into and down the well tube, being discharged through the teeth of the boring tool at the bottom, the water bringing the borings up on the outside of the tube, and as the tube is rotated it is lowered as the earth is cut away. In several instances in some of the deep alluvial deposits in the valleys of California 529 ft. have been sunk in 8 hours by this method.

The vacuum automatic brake has been adopted in India, and the Government of India, upon recommendation of the Committee of Locomotive and Carriage Superintendents, has ordered the general adoption on all standard gage State Railways of a uniform pattern of connections for the vacuum brake, and suggested its adoption by all guaranteed and other railways. On the East Indian Ry., it is stated, arrangements have been made to equip over 100 engines and 1,500 passenger cars with this brake, and the Great Indian Peninsula Ry. has also agreed to fit up the joint stock of that line and the East Indian Ry. with the improved pattern. Several other railways have also decided to adopt the brake, as recommended.

COMPOUND VS. SIMPLE ENGINES FOR CABLE RAILWAY PLANTS.

In our issue of May 12 we gave some particulars of the engines of the driving plant for the new Broadway cable railway in New York. These engines, as well as the engines of the Third Ave. cable railway, New York, will be of the simple, non-condensing type, and the adoption of this type of engine has led to considerable discussion respecting the comparative methods of simple and compound non-condensing engines for this class of service. In response to inquiries from the editor of "Power," three engineers of much practical experience in cable railway plant have given their opinion on this point, which is likely to be a disputed one for some time to come, as the variable loads of cable railways are not favorable to the use of compound engines. The first letter is from Mr. A. N. Connett, Chief Engineer of the Baltimore City Passenger Ry., Baltimore, Md., who favors the compound system and thinks it will save 5 lbs. of steam per HP. per hour. He says further:

I am now installing three plants for this company and in all I am using compound engines to run non-condensing. I consider that the constant load will be large enough to keep the low pressure cylinders from ever expanding below atmosphere. They have proved moderately successful on electric railway plants, and

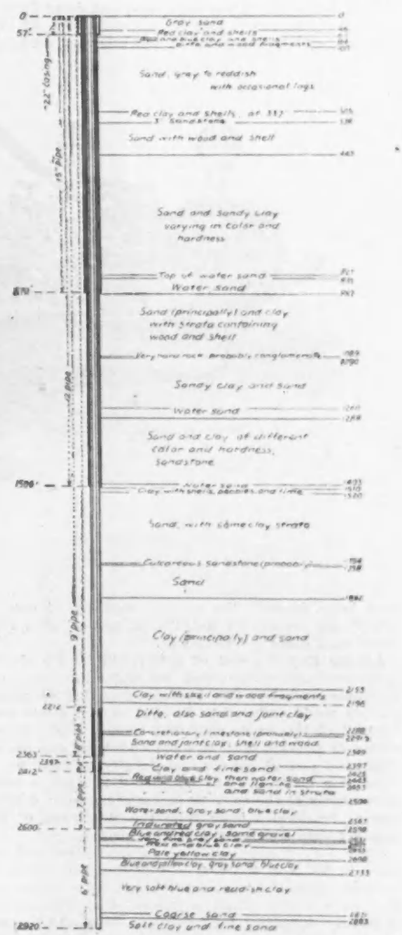


Fig. 3. Section Showing Strata Pierced by the Well.

the service there is a more variable one than on cable plants. The Seventh St. road in Washington (cable) is showing an admirably economical result in the use of compound condensing engines. Of course it can be readily said that there is no danger of back pressure with such engines. But I think you state the case fairly when you say that the automatic proportioning of the loads between the cylinders will always give the low pressure cylinder sufficient initial pressure to make its introduction an object. The Brooklyn Bridge example is a poor one. The variation of loads is largely in excess of most street railway plants. The Broadway and Third Ave. lines, I think, should have remarkably steady loads. The condition of loading and alinement

there cannot but make it so. The same will prove true in a somewhat less degree with the plants being installed by our company.

The second letter is from Mr. F. W. Wood, Manager of the Temple St. Cable Ry. Co., Los Angeles, Cal., who looks with little favor on the compound system, considering it advantageous only under specially favorable circumstances. The Los Angeles cable railways were described in our issue of Nov. 7, 1891. He says:

That the use of compound engines is economical under certain conditions all engineers will admit. That compound engines do as a fact operate satisfactorily in some cable railway power houses is also not to be disputed. That the conditions of cable railway practice are unfavorable for the best operation of compound engines is equally true.

The percentage which the cost of power bears to the whole cost of operating seems to me to be a necessary factor in deciding upon the character of power plant to be used. This percentage is variable, and may range from 25% to as low as 6%. It is manifest that in dealing with an item that amounts to 20 or 25% of the whole cost of operation, much more money may be invested and complications introduced than would be warrantable if the item ranged lower than 10%.

In those cities where the price of coal is $10 per ton, the cost of power is a large item, and complications in the engine room and expense for condensing apparatus and water may well be incurred, and the added risk of accidents and consequent delay from all these may be borne. But if fuel costs from $2 to $3 per ton, and if the traffic of the proposed road is of very large amount, the possible economy of cost of power may become an insignificant matter when compared with other considerations.

Assume that the cost of power will be 6% of the whole operating charge, and that under the rather unfavorable conditions 20% is the saving that compound engines would accomplish, the real saving would then be 1.2% of the whole operating charge. Now, if this saving is accomplished at some additional expense of plant and cost of repairs and liability to accident, it becomes a question as to whether it is wise to make the economy at the cost. It seems to me to be a question to be decided more from the standpoint of the manager than from that of the engineer.

While I fully appreciate the value of compound engines in the use of steam and in the distribution of working strains, my experience has also taught me that the economy which is purchased at the expense of added mechanism may prove to be dearly bought; and I should be very conservative in criticising the use of simple engines when coal is $3 per ton and the traffic of the road of great volume.

I know of one horse power provided with well designed compound engines (and these engines with complicated attachments on the valve gear for increasing the range of cut-off) in which the low pressure cylinder is and always has been idle, and from the valve gear of which all the attachments that so much was expected of have been removed, until the whole has been reduced to a simple and fairly economical Corliss engine. In other instances the original complicated engines have been removed, and replaced by smaller simple engines, to the great economy of the operation.

With reference to the particular question: Would compound engines have been preferable in the New York power houses to simple ones? I think it is safe to assume that the designers have considered the whole matter; and that the small percentage of the total expense which the power item will probably be, and the great importance of avoiding possibly delay in the very large traffic to be handled, and the fact that the variations of load incident to cable railway work would place the compound engines under unfavorable conditions, have led them to adopt the simplest possible means of producing power, and their action is not in any sense to be regarded as evincing lack of appreciation of or faith in the principle of compounding a steam engine.

If anything goes wrong in one power unit in an electric road, the design is usually such that this particular unit may be cut out for repair without delay to the system. This is impracticable in cable railway practice, hence the prime importance of avoiding possible accidents, especially under the conditions which obtain in very large cities.

Again, the percentage which the cost of power bears to the whole operating cost decreases as a cable road is worked to its maximum capacity; and the nearer the maximum capacity is approached the greater will be the proportion of variable load, and consequently the conditions for the good working of the compound engines are still further departed from. These are exactly the conditions that will probably arise in a cable road in New York. And the engineer, who under other conditions, would install triple expansion engines might well use simple engines here.

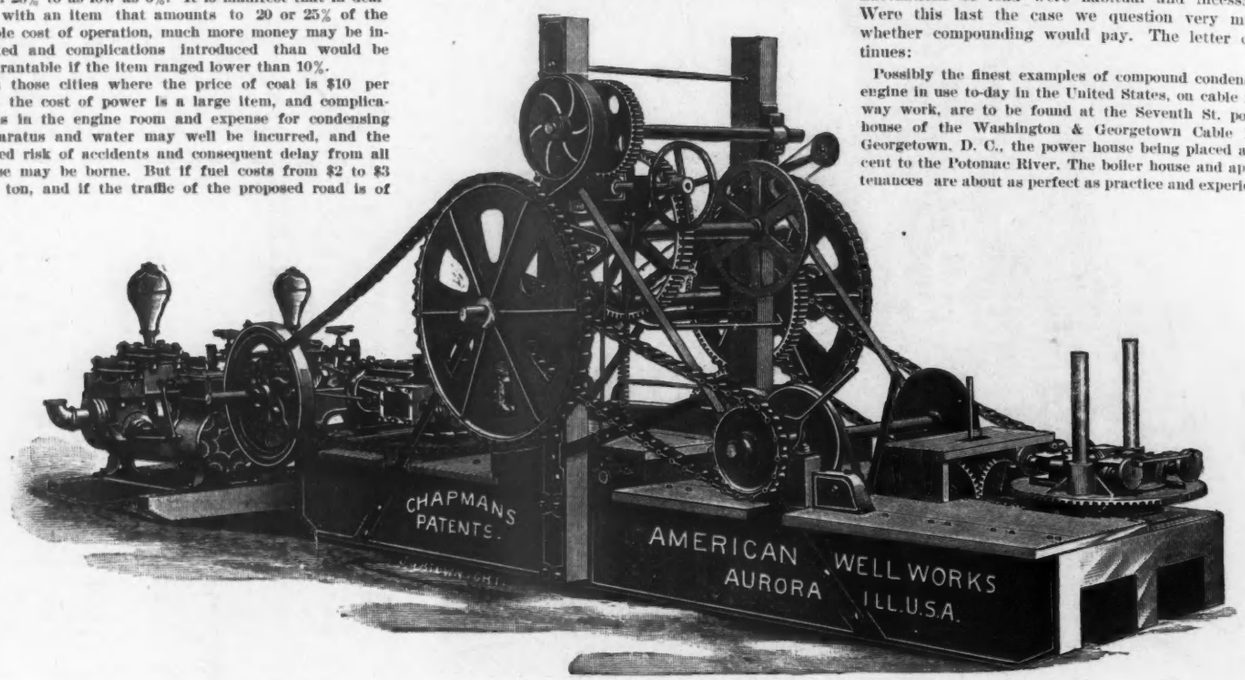


FIG. 4. WELL SINKING MACHINERY.

The third letter is said to be from a man of several years' successful experience in cable railway work and heavy power transmission machinery, and is decidedly favorable to the compound system:

There is not the least doubt but that the majority of cable railways to-day, in this country, are driven by high-pressure engines, of the Corliss or automatic type. It is very questionable whether a well-designed and proper Corliss engine (for the work to be done), working at the most economical point of cut-off for the average duty, can be compared with the compound non-condensing engine, even when the wear and tear of the extra parts, and the loss by radiation in two cylinders are taken into account. The difference in cost between the simple and compound engines would be very small.

I have never heard of a case where a change has been made from a high pressure automatic Corliss engine to that of a compound non-condensing. The compound engine of to-day will undoubtedly do the same work at less cost than a high pressure engine, as the compound engine simply carries the expansion of steam to its greatest limit. Where it is possible to condense, in connection with the compound engine, there need not be the slightest question as to economy, or hesitancy in using this class of engine in driving cable railways, as well as any other plant or class of machinery. The varying power required on a cable railway is unquestionably considerable, but no more so than in rolling mills, or in the triple expansion engines as used on our large transatlantic steamers. Take for illustration the engines of the "City of Paris," or the "City of New York," of 20,000 HP. Consider that these vessels in a storm have their propellers whirling in the air at one moment, and the next plunged into the water. In this case we have triple expansion engines, with condensing included, so that if such engines answer under the conditions stated, there is no real reason why they should not answer in cable railways, or other work.

This last is a weak argument, because no one supposes that the engines are working economically, or that the compound type is of any great advantage when the ship is pitching so heavily that the screw is frequently out of water; but taking the year round this does not occur for more than 1% of the time that the engines are in motion. Therefore this variableness of load is of no practical effect on the economy in use of steam, as it would be if such fluctuations of load were habitual and incessant. Were this last the case we question very much whether compounding would pay. The letter continues:

Possibly the finest examples of compound condensing engine in use to-day in the United States, on cable railway work, are to be found at the Seventh St. power house of the Washington & Georgetown Cable Ry., Georgetown, D. C., the power house being placed adjacent to the Potomac River. The boiler house and appurtenances are about as perfect as practice and experience can make them. I have recently heard of a cable plant to be erected in San Francisco, in which vertical triple expansion condensing engines will be used, which I think is a step in the right direction. The engines will be placed directly on the center driving shaft, and make 115 revs. per minute, using a much smaller pinion than has been customary in a cable railway construction, thus getting a higher piston speed, higher velocity on the main shaft, and reducing its diameter to the minimum. The high initial velocity will no doubt help to keep the cable steadier.

Railway accidents in India during the first nine months of 1891 are said to have shown an increase of preventible and a decrease in non-preventible accidents. Collisions between passenger trains and freight trains and cars standing foul of the track were almost doubled and the number of derailments of passenger trains also greatly increased. The total casualties to passengers also exceeded previous records, for the numbers are 455 killed as against 363 in the first nine months of 1890, and 724 injured against 673. In addition to this, 38 persons were killed and 153 injured in yards and workshops.

An unusually large caisson is being used in the construction of the breakwater for the port at Cuxhaven, near the mouth of the Elbe River, Germany. It measures 410 ft. in length by 39.4 ft. width and 49.2 ft. height, according to the "Zeitschrift fuer Transportwesen und Strassenbau." The shell consists of iron boiler plates. To facilitate the towing of the caisson from the machine shops at Altona to its destination, its bottom had to be filled with concrete to a depth of 6.5 ft. As soon as this caisson is sunk in place and filled with concrete, the construction of a second, to be sunk alongside the first one, is to be commenced.

THE GRANT LOCOMOTIVE WORKS.

The following notes on the very complete shops and tools of the new works recently completed at Chicago for the Grant Locomotive Works (formerly of Paterson, N. J.) we abbreviate from "Locomotive Engineering." Thus far only repair work has been done, but it is stated that five consolidation engines are to be built for stock, as a commencement. The electric cranes were described in our issues of April 21 and July 21.

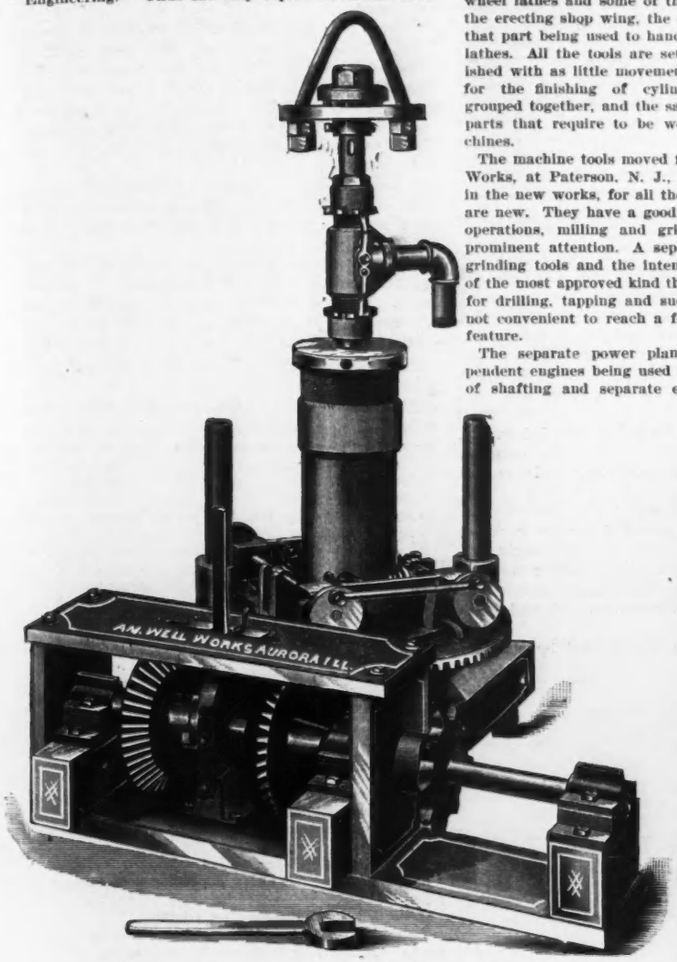


FIG. 5. REVERSIBLE ROTARY MACHINE; AMERICAN WELL WORKS.

The shops have not been built on the plan of any other locomotive works; but it is evident that much thought has been devoted to making them models of convenience and perfect in arrangement. The designers of shops like these have an enviable problem to work out, compared to those who are left to struggle to enlarge an old establishment, and keep it in harmonious shape. They had an open prairie to plan on, and they have worked to the end of building shops where material can be converted into locomotives, with the lowest possible amount of handling and where the work shall be done on tools that are the best of their kind.

Fig. 6. Cutting Edge of Drill for Artesian Well.

The main buildings consisting of the machine shop and erecting shop is built in the L-form, the long leg being the machine shop, which is a finely lighted building, with galleries upstairs for light tools. The floor is traversed by a traveling crane, which takes the work to and from the heavy tools that are purposely set so that they can be reached by the cranes. The wheel lathes and some of the heavier tools are set in the erecting shop wing, the overhead crane that serves that part being used to handle the work for the wheel lathes. All the tools are set so that work will be finished with as little movement as possible, all the tools for the finishing of cylinders, for instance, being grouped together, and the same with frames and other parts that require to be worked on by different machines.

The machine tools moved from the Grant Locomotive Works, at Paterson, N. J., appear to cut little figure in the new works, for all the most important machines are new. They have a good supply of tools for special operations, milling and grinding evidently receiving prominent attention. A separate shop is provided for grinding tools and the intention is to have everything of the most approved kind therein. Portable appliances for drilling, tapping and such light work, where it is not convenient to reach a foundation tool, are quite a feature.

The separate power plan has been adopted, independent engines being used to drive the principal lines of shafting and separate engines for the machinery in various shops. The erecting shop is arranged with pits set at right angles to the shop, a transfer table being employed to take the engines out. A careful study was made of the leading erecting shops in this country, both of builders and railway establishments, and it was concluded that the stall plan was more convenient than the longitudinal floor plan, where engines must be lifted by a crane. The cranes in this erecting shop (Eng. News, April 21), are powerful enough to lift an engine, but they will not be used much for that purpose. The machine shop and erecting shop are ready for business, but the other shops are scarcely in working order yet. The firm has already done some repairing and has engaged to do a great deal more. Those in charge think that the works can be conveniently organized and put gradually in operation while doing repair work. Mr. Edwin M. Herr, the Superintendent of the works, is working things into shape very rapidly. He has an able lieutenant in Mr. P. Arnot, master mechanic of the shops, who was long superintendent of the Grant Locomotive Works, at Paterson.

The original purpose was to start the boiler shop with an ancient steam riveting plant, but the President, Mr. Fenner, has ordered an entire outfit of Wood's hydraulic machinery. When this plant is in nearly all operations in the boiler shop will be performed by hydraulic tools.

The blacksmith shop has the most approved form of forges, with down draft leading to pipes under the floor, the gases being drawn in by an exhaust fan. The foundry appears to be particularly well designed and equipped. There are two Cottian furnaces, supplied with material by an elevated railway outside. A traveling crane traverses the whole shop and handles everything for the coke ovens, besides the ordinary floor work. The only familiar thing lacking was the molding machine, which will no doubt get there in time.

The management is to be congratulated on the progress they are making to produce a model locomotive building plant.

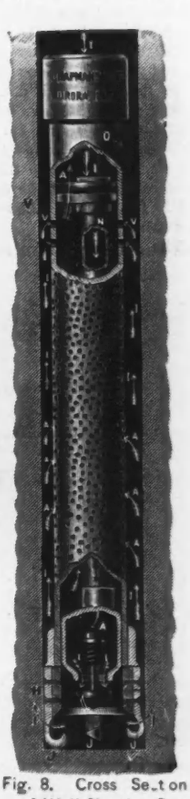


Fig. 8. Cross Section of Well Showing Bottom Section of Pipe.

ELECTRIC TRANSMISSION OF POWER AT ALBINO.

The plant for the electric transmission of power at Albino, near Bergamo, is constructed with a view of combining great simplicity and completeness of arrangement, with large amount of power. The "Schweizerische Bauzeitung" gives the following description:

A weir of 374 ft. length and 8.2 ft. height was constructed across the river Serio, and its water conducted to the turbine house at Cene by a canal 2,625 ft. long, and a pipe line 1,804.4 ft. long and 70.9 ins. in diameter. The available fall of the water is 49 ft.

The turbine house is fitted with three turbines of 325 HP. each, the vertical axles of which also carry the inductors of the dynamo machines. The power thus derived is transmitted to a great spinning and weaving establishment at Albino, by a conduit of 9,842.7 ft. length, strung on poles. This establishment mentioned has heretofore used steam combined with water-power. The electro-motors employed are connected directly with the transmittors by belting. The effective working power derived amounts to 80%.

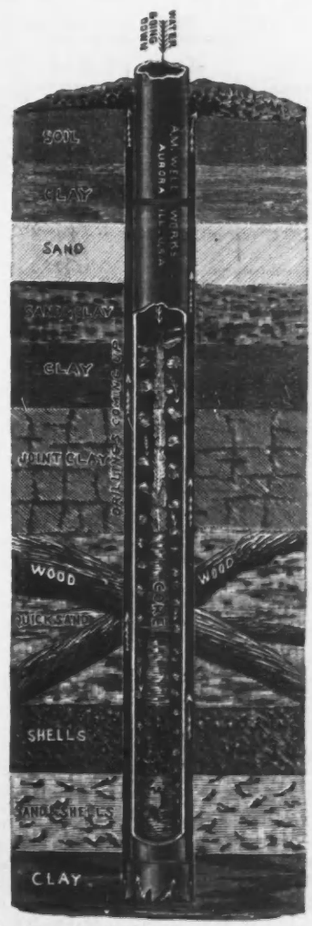


Fig. 7. Cross Section of Well in Alluvial Deposit in the Gulf Coast.

TABLE OF COEFFICIENTS FOR FIGURING STRAINS IN ROOF TRUSSES.

We have received from Mr. M. J. Patterson, Denver, Colo., the following tables of coefficients for strains in roof trusses of the type shown in the accompanying diagram. Table No. 1 is a copy of a table published in Engineering News some years ago, with the exception that the marking of the members has been changed in order to get a more easily memorized order. Mr. Patterson describes the tables as follows:

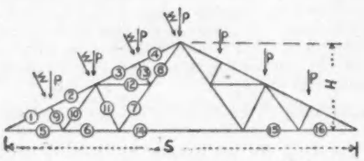


Diagram of Roof Truss.

The defect of this table, No. 1, is that it provides no method of estimating wind strains, except upon the ordinary but very erroneous assumption that the wind acts vertically and upon both sides of the roof at once. With this assumption the wind load may be, and usually is, lumped in with the load from snow and weight of structure. Having occasion recently to figure a large number of trusses of this type, it occurred to me to make up Table No. 2. This being based upon a wind force acting normally on one side of the roof at a time, will give as nearly accurate a result as our knowledge of wind action will permit, and with but a slight increase in the labor of figuring. As will be noted, the pound load dead and pound load of wind force having been computed, it is necessary to set a slide rule but twice to read all the strains. With steep pitches the possible reversion of strain noted may become important.

TABLE I.

Strains for Dead Load P at Each Panel Point Acting Vertically.

Member.	$N=3$.	$N=4$.	$N=5$.	General Formulas.
	Multipliers of P.			
1	6.31	7.83	9.42	$+7+4P\sqrt{(N^2+4)}$
2	5.755	7.38	9.053	$+P(7+4N^2+5)+\sqrt{(N^2+4)}$
3	5.2	6.93	8.68	$+P(7+4N^2+3)+\sqrt{(N^2+4)}$
4	4.646	6.485	8.31	$+P(7+4N^2+1)+\sqrt{(N^2+4)}$
5	5.25	7.0	8.75	$-7+4NP$
6	4.5	6.0	7.5	$-3+2NP$
7	1.5	2.0	2.5	$-1+2NP$
8	2.25	3.0	3.75	$-3+4NP$
9	0.832	0.895	0.929	$+NP+\sqrt{(N^2+4)}$
10	0.75	1.0	1.25	$-NP+4$
11	1.66	1.79	1.86	$+2NP+\sqrt{(N^2+4)}$
12	0.75	1.0	1.25	$-NP+4$
13	0.832	0.895	0.929	$+NP+\sqrt{(N^2+4}$
14	3.0	4.0	5.0	$-NP$

TABLE II.

Strains for Wind Load W at Each Panel Point on Windward Side, Acting Normally to Roof.

Member.	$N=3$.	$N=4$.	$N=5$.	General Formulas.
	Multipliers of W.			
1	3.08	4.5	5.85	$+W(5+4N-2+N)$
2	3.08	4.5	5.85	" "
3	3.08	4.5	5.85	" "
4	3.08	4.5	5.85	" "
5	4.51	5.596	6.73	$-5+4W\sqrt{(N^2+4)}$
6	3.605	4.47	5.386	$-W\sqrt{(N^2+4)}$
7	1.802	2.236	2.693	$-W+2\sqrt{(N^2+4)}$
8	2.704	3.354	4.04	$-3+4W\sqrt{(N^2+4)}$
9	1.0	1.0	1.0	$+W$
10	0.901	1.12	1.346	$-W+4\sqrt{(N^2+4)}$
11	2.0	2.0	2.0	$+2W$
12	0.901	1.12	1.346	$-W+4\sqrt{(N^2+4)}$
13	1.0	1.0	1.0	$+W$
14	1.802	2.236	2.693	$-W+2\sqrt{(N^2+4)}$

Table No. 2 gives maximum strains on the windward side occurring in any one of three cases: 1, both ends fixed; 2, leeward end on rollers; 3, windward end on rollers. The strains on the leeward side of the truss are in every case the same in character and less in quantity except in the following case: With the windward end on rollers, the wind strain in members 14, 15 and 16 is given by the formula:

$$\frac{W(N^2-10)}{2\sqrt{(N^2+4)}}$$

This gives compression when N is less than $3.162\times\sqrt{10}$. N equals S divided by H, or the span divided by the height of the truss. Coefficients for intermediate values of N may be found with practical accuracy by interpolation. In the tables + indicates compression and — indicates tension. In Table No. 1 all the figures in the three columns of H are multipliers of P—that is, they must be multiplied by the dead load acting at each panel point to obtain the strain. In Table No. 2 all the figures in the three columns of N are multipliers of W—that is, they must be multiplied by the wind load at each panel point on the windward side, acting normally to the roof.

COST OF WATER MAINS IN PLACE AT GREAT FALLS, MONT.

In the spring of 1891 the Great Falls Water Co., of Great Falls, Mont., advertised for bids for pipelaying. The bids received were high and the company resolved to do the work. Mr. E. W. King, Secretary of the company, has sent us a blue print copy of a table giving the detailed cost of the work from which we abstract the information given below. Mr. King did not directly state whether the company saved money by doing the work, but his letter conveys the idea that it did.

The pipe, which was 8, 6 and 4-in. cast iron, an aggregate of 41,368 ft., cost $26 per ton at West Superior, Wis. Added to this was $18 freight and 70 cts. for cartage to the trenches, making the total cost of the pipe at the trenches $44.70. Labor cost $2.25 for digging, $2.50 for men on rock and $3.50 for calkers.

The 41,368 ft. of pipe was divided by sizes as follows: 5,715 ft. of 8-in.; 35,212 of 6-in.; 1,389 ft. 4-in. Nearly all of the 4-in. pipe was for hydrant branches, of which there were 76, each 12 ft. long, making a total of 912 out of the 1,389 ft.

The total weight of the special castings was 26,640 lbs., and their cost $1,199.87, or 4.5 cts. per lb., delivered. The amount of lead used was 38,750 lbs., which cost a total of $2,714, or 7 cts. per lb., delivered. There were 46 gates and gate-boxes and 76 hydrants. The exact number of gates of various sizes was not given, but probably most of them were 6-in. gates. The average cost of the gates, delivered, was about $22. The hydrants cost $34 each, delivered.

There was a total of 28,887 cu. yds. of excavation, of which 25,489 cu. yds. were earth, 1,892 cu. yds. loose rock, and 1,506 cu. yds. of solid rock. The cost for the different materials is not given separately, but the total cost was $8,739, or about 34 cts. per cu. yd. The cost of back filling and tamping was $855, or about 3.4 cts. for each cubic yard of excavation.

The miscellaneous expenses connected with laying the 41,368 ft. of pipe, including yarn, fuel, tools, tool repairs, powder, caps and fuse amounted to $1,033.

The total cost of the whole length of pipe was $54,004, not including engineering or superintendence. The figures are not given so the cost per foot for each size of pipe can be given, but the average cost of the 8, 6 and 4-in. pipe in place, with specials, gates, gate-boxes and hydrants was $1.30½ per ft.

DIAGRAMS FOR FLOW IN PIPE SEWERS.*

Kutter's formula for the flow of water in pipes, conduits, channels and streams has obtained wide acceptance among engineers on account of its great flexibility and adaptability to varying conditions of slope, depth and roughness of channel. Its objectionable feature is that its complex nature requires tedious computations in its application. Within the range of the gradients of sewers, the formula may be simplified and yet remain within the necessary limits of accuracy: and the diagrams herewith presented render the use of this reliable formula simple and rapid for obtaining the velocity and discharge of ordinary vitrified pipe sewers.

Kutter's formula in feet measure is

$$V=C\sqrt{RS}=\frac{41.66+\frac{1.811}{n}+\frac{0.00281}{S}}{1+(41.66+\frac{0.00281}{S})\frac{n}{\sqrt{R}}}\sqrt{RS}$$

in which

R=hydraulic mean radius, found by dividing the area of cross section by the wetted perimeter.

S=gradient, or sine of inclination, or fall in feet per foot.

V=velocity in feet per second.

n=coefficient of roughness, depending upon surface of pipe.

C=cocificient represented by friction.

The value of the coefficient of roughness (n) is generally considered by engineers as .013 for pipe sewers under usual conditions. For clean, smooth pipe, it may easily be .012, and some observations have given as low as .010. For pipe sewers laid under usual conditions, even when they are not thoroughly flushed, .013 may be used with safe results, and this value has been chosen for calculating the diagrams. For selected pipe, well laid and thoroughly flushed, .012 will probably give correct results.

Calculations on the effect of substituting .012 for .013 show that the increase in the velocity, and therefore in the discharge, ranges from 10.1% for 24-in. pipe to 11.3% for 6-in. pipe, with an average of 10.7% for all the sizes of pipe used in the diagram. However, it will be sufficiently accurate to add 10% to the values obtained with n=.013 in order to find the values with n=.012. In a similar manner it may be shown that n=.015 gives results 17 to 18% less than n=.013.

While changes in S at the light grade of rivers, canals, and very large sewers affect the value of C considerably, the widest variations in the grades with which pipe sewers are used have a comparatively small effect. If C be calculated with S=.0001, and this value of C be used for computing V for other gradients, the result will exceed the true value of the original formula for grades steeper than .001 and fall short for lighter grades. For 24-in. pipe this error will be 1.3% when S=.0005, and also when S=.04. For 12-in. pipe the error reaches 1.8% at the same gradients. As these inclinations represent the extremes of practice,

*By Arthur N. Talbot, Prof. Municipal Eng., Univ. Ill. The author writes that since the article was in type he has accidentally found that a diagram involving the same principles was published by Rudolph Hering, C. E., in Trans. Am. Soc. C. E. for 1879. The latter's diagrams, however, while covering a wider range of coefficients, etc., were in not quite such convenient form for use. The writer expresses his obligation to A. B. Loomis, '93, and R. C. Vail, '93, for valuable assistance in the computations and in the preparation of drawings. The paper was first published in "The Technograph" of the University of Illinois.

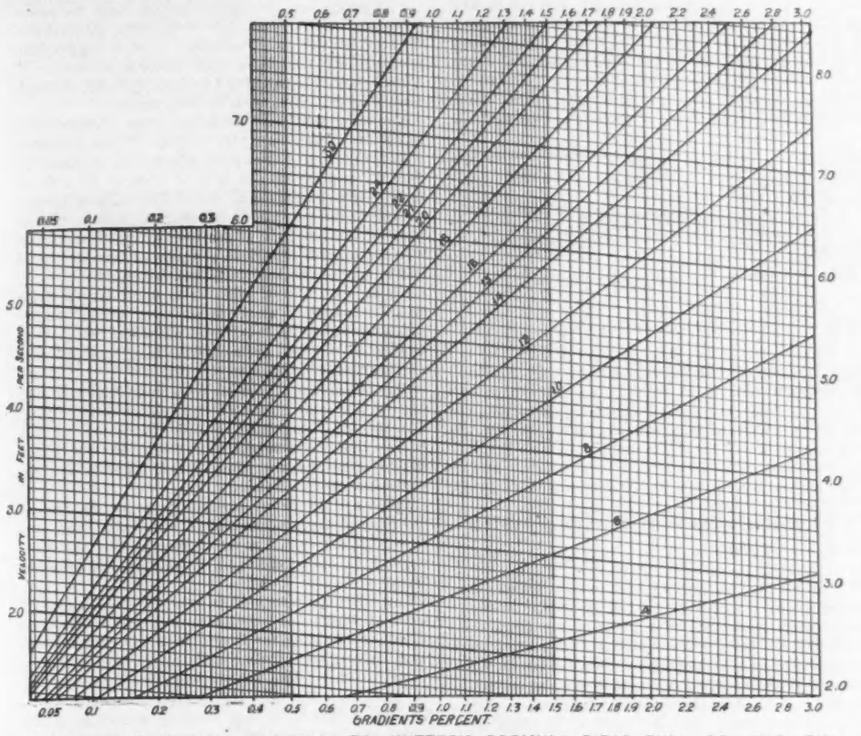


DIAGRAM OF VELOCITIES ACCORDING TO KUTTER'S FORMULA, PIPES FULL OR HALF FULL.
(N = .013; With N = .012 Add 10%.)

and as the error decreases rapidly toward S=.001, this form is well within the limits of accuracy required in sewerage practice, especially as there are considerable variations in the size and roughness of pipe and great uncertainty in other data for sewer requirements.

Using S=.001 and calling n=.012, .013 and .015 respectively, the coefficient C in Kutter's formula becomes

$$\frac{195.39}{1+\frac{.534}{\sqrt{R}}}, \quad \frac{183.78}{1+\frac{.578}{\sqrt{R}}}, \text{ and } \frac{165.2}{1+\frac{.667}{\sqrt{R}}}.$$

When R for particular sizes of pipe is substituted in the formula, it reduces to the form $V = m\sqrt{S}$, where m represents the resulting constant. Substituting x for $\sqrt{S}$, the formula becomes $V = mx$ the equation of a straight line passing through the origin. This property may be utilized by plotting the square roots of the gradients as abscissas and the velocity as ordinates, when the flow of any pipe will be represented by a straight line. The diagrams are constructed on this principle. The abscissas are laid off as the square root of the gradient and the ordinates directly as the velocity, and each size of pipe is represented by a straight line. The origin does not come within the limits of the diagram. The axes of abscissas and ordinates are placed at an oblique angle in order to obtain better intersections and to increase the range of the diagram. The equation of discharge of pipes will likewise be shown by straight lines, since it is the product of the velocity by a constant area of cross section.

Great care was taken in the construction of the diagrams. Every computation was made by two computers, usually with the aid of the Thomas computing machine, the Thacher slide rule, or logarithms, and four points were obtained for every velocity and discharge line; so the check on both calculation and drawing makes it reasonably certain that there are no errors of any consequence.

The explanation given of the two diagrams we omit, as the diagrams seem to us sufficiently clear without explanation. The obliquity of the axes of co-ordinates is merely to give better intersections and bring the desired range within a more convenient area. The velocities are for pipes running either full or half full. For values at other depths the author gives the following table and note:

Velocity and Discharge of Pipes Partially Full.—The flow of pipes partially full is frequently of importance, as when the depth and velocity of a sewer at its minimum discharge are desired. While it is common to consider that for the same pipe the velocity varies as the square root of the hydraulic mean radius of the section covered at the given depth, or in other words that C remains constant for different depths, yet Kutter's formula gives different results. The Darcy-Bazin experiments are the only ones known to the writer in which observations at different depths of circular pipes have been made, and these extended only to half full. The results are considerably closer to Kutter's formula than to the assumption that C remains constant. As Kutter's gives a smaller value for depths below the center, it is on the safe side. While the formulas indicate a greater flow for depths from eight-tenths full to full than when flowing full, no great reliance should be placed on this excess. It is safe to say that above eight-tenths of the diameter the discharge is at least as great as when flowing full, and that above half the diameter the velocity is more than when flowing full or half full.

The following table gives the velocity and discharge at different depths in terms of the velocity and discharge when flowing full, both on the assumption that C remains constant and that it varies as given by Kutter's formula. The values by Kutter's are averages for the different sizes of pipes, but the variation in any case is comparatively small. The depth is given in terms of the diameter.

	(C) Constant.		Kutter.	
Depth.	Velocity.	Discharge.	Velocity.	Discharge.
1.0	1.00	1.00	1.00	1.00
0.9	1.09	.99	1.14	1.08
0.8	1.10	.94	1.15	.99
.07	1.09	.82	1.12	.84
0.6	1.05	.66	1.08	.68
0.5	1.00	.50	1.00	.50
0.4	.93	.35	.89	.33
0.2	.70	.10	.57	.08
0.1	.50	.02	.34	.02

To find the velocity or discharge at any given depth, divide the depth by the diameter and multiply the velocity or discharge of full pipes as found in the diagrams by the value given in the table opposite the partial depth. To find the depth of flow, divide the given velocity or discharge by the quantity found in the diagram and find in the table the depth which gives a value nearest this quotient.

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 98.)

South Framingham, Mass.

The best example of intermittent downward filtration combined with broad irrigation as used for the purification of the sewage of a town in this country is to be found in South Framingham, Mass. Although this plant has not yet been in operation three years, it is the oldest of its kind in Massachusetts, where the greatest attention has been paid to sewage purification. A small intermittent filtration system at Medfield, Mass., was put in operation late in 1886 or early in 1887, but broad irrigation is not used there.

The steps which led up to sewage purification at South Framingham are interesting. As was stated

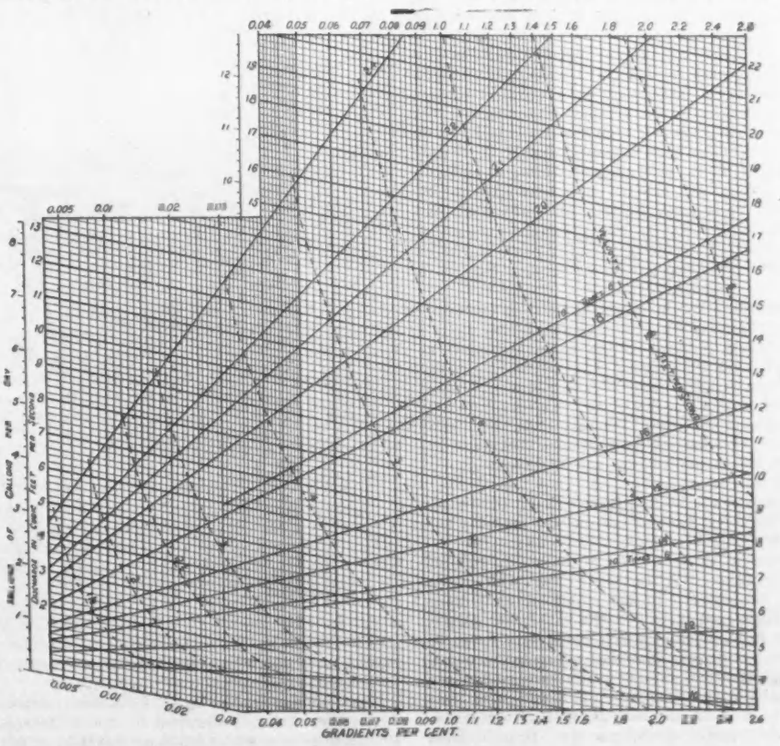


DIAGRAM OF DISCHARGE ACCORDING TO KUTTER'S FORMULA, PIPES FLOWING FULL.
(N = .013; With N = .012 Add 10%.)

in our issue of July 28, 1891, Boston was influential in the establishment of this plant, it having taken the water of the adjacent rivers and ponds to increase its supply in 1878, directly after which efforts were made to secure the exclusion of sewage from its new water supply.

This agitation on the part of Boston and other lo-

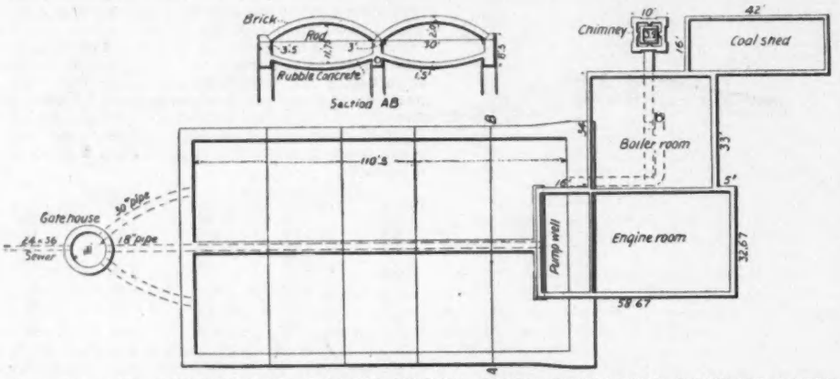


FIG. 2. PLAN OF RESERVOIRS AND PUMPING STATION, SOUTH FRAMINGHAM SEWERAGE SYSTEM; S. C. Heald, M. Am. Soc. C. E., Engineer.

calities interested in the general subject of abating nuisances caused by the sewage of towns led to the appointment in 1884 of a State Drainage Commission to investigate methods of sewage disposal and the protection of the water supplies where needed. Mr. E. C. Clarke, M. Am. Soc. C. E., was engineer of the commission, which recommended that South Framingham and Natick construct a joint system, purifying the sewage about as it is now done at South Framingham and as proposed at Natick. Messrs. J. P. Davis and Rudolph Hering, M's. Am. Soc. C. E., indorsed the recommendations of Mr. Clarke. In January, 1887, Mr. H. H. Carter, M. Am. Soc. C. E., reported to the Boston Water Board also recommending land filtration as the best means of purifying the sewage of South Framingham.

In 1885 the Framingham Water Co. introduced a public water supply, increasing the need of sanitary improvement. In the same year, 1885, Boston instituted a suit against the town of Framingham, of which South Framingham is the principal village, for the abatement of the pollution of the former's water supply.

Without following out the further details of the movement, it may be said that Boston finally offered to contribute $25,000 toward the removal of sewage from its drainage area, provided Framingham carried out the plans which were finally adopted as outlined below. The town employed Mr. S. C. Heald, M. Am. Soc. C. E., of Worcester, Mass., as engineer of the system. Mr. Heald's plans were approved by Mr. Phineas Ball, C. E., also of Worcester. The construction of the plant was under the direction of Mr. J. J. Van Valkenburg, C. E., of South Framingham. The plant was put in operation in the fall of 1889.

Before describing the disposal area some facts may be given regarding other parts of the system.

The village of South Framingham is located in the town of Framingham. The population of the whole town in 1890 was 9,239, of which 6,000 may have been resident in the village. The separate system of sewers is in use. Feb. 29, 1892, there were connected with the sewerage system 268 buildings, of which 236 were dwellings and 32 business blocks and manufactories.

The main sewer leading from and out of the village to the receiving reservoirs at the pumping station is oval shaped, of brick, 24 × 36 ins.

The volume to be treated is materially reduced by underdrains laid in connection with about half of the sewers. In the spring of 1891 these drains discharged from 200,000 to 500,000 gallons of water daily, much of which would have found its way into the sewers, otherwise necessitating pumping and purification. The underdrains were laid in a bed of gravel placed beneath the sewer, with their flow lines 8 to 12 ins. beneath that of the sewer. The underdrainage discharges into Beaver Dam Brook, about 2½ miles from the point where the latter flows into Lake Cochituate. The city of Boston objected to this underdrain and refused to pay the $25,000 toward the cost of the system, claiming that it was not included in the original plans, and that leakage from the sewer would enter the drain and contaminate Boston's water supply. To Jan. 1, 1892, the amount had not been paid. The State Board of Health on Sept. 2, 1890, reported that an analysis of the water had been made before the sewers were put in use in the fall of 1889, and each month since January, 1890. The water from the drain had not been worse, on the whole, since the sewers were put in operation. But the board concluded that Boston's water supply would be better if the underdrain did not discharge into Beaver Dam Brook, and advised that the town of Framingham and the city of Boston co-operate in pumping the water to the filtering area.

The arrangement and dimensions of the gate house, reservoirs and pumping station are shown by Fig. 2, which gives a plan of them and a section through the reservoirs.

Screens were put in to remove some of the coarser matter from the sewage near the beginning of 1892.

The combined capacity of the reservoirs is 431,000 gallons. The reservoirs are ventilated by connecting them with the chimney, as shown by the plan. June 17, 1892, the writer visited this pumping station. The day was very warm, but no odor was noticeable about the reservoirs or buildings. The pumping station presents a pleasing appearance from an architectural point of view.

The pumping engine is a Davidson compound duplex condensing, guaranteed to deliver 2,000,000 gallons of sewage per day through 9,000 ft. of 12-in. pipe against a total head of 40 ft., not including friction.

The pumps are run each forenoon until the reservoirs are empty. June 17, 1892, about 200,000 gallons of sewage were pumped. The average daily pumpage was said to be about 250,000 gallons.

There are two horizontal tubular steel boilers, each 4 ft. × 13 ft. 2 ins., with 52 3-in. tubes.

The force main is of 12-in. cast iron, 9,740 ft. long to the first manhole, where it ends. From this manhole 2,000 ft. of Akron pipe, first 15 ins. in diameter, then 12 and 10 ins., is laid at a grade of 1 ft. in 1,000 across the disposal area. The highest ground on the farm is 44.2 ft. above the bottom of the reservoir and 27.2 ft. above the valves of the pump. The force main is laid to a grade so that its whole length may be drained back into the reservoir.

Along the line of the force main eleven 6-in. plugged branches were placed from which sewage could be drawn by those who wished to use it as a fertilizer. So far, or to June, 1892, no one had availed himself of this opportunity.

The location of the filter beds and irrigation field and of the other parts of the system is shown by Fig. 3. This map also shows the limits of the Beaver Dam Brook district of the Boston water supply. The disposal area, it will be seen, lies entirely outside this district.

There are 14 hexagonal manholes on the line of the pipe at the sewage farm. Generally there are four 8-in. regulating gates in the sides of the manholes, 1 ft. above the land which they are intended to serve.

The farm contains a little over 69 acres, about 12 acres of which has been laid out in eleven beds, as shown on the map, for intermittent downward filtration. About two-thirds of the entire area was formerly wooded. The timber was cut from most of the area but has been left standing on some of it. The soil is said to be very good for filtration.

The beds for intermittent filtration are banks about 3 ft. high, 4 ft. broad at the top, with slopes of 1½ to 1. The bank containing the main pipe is somewhat higher in places. A ditch extends around some of the beds from which channels 9 ins. deep and 18 ins. wide extend and carry the sewage.

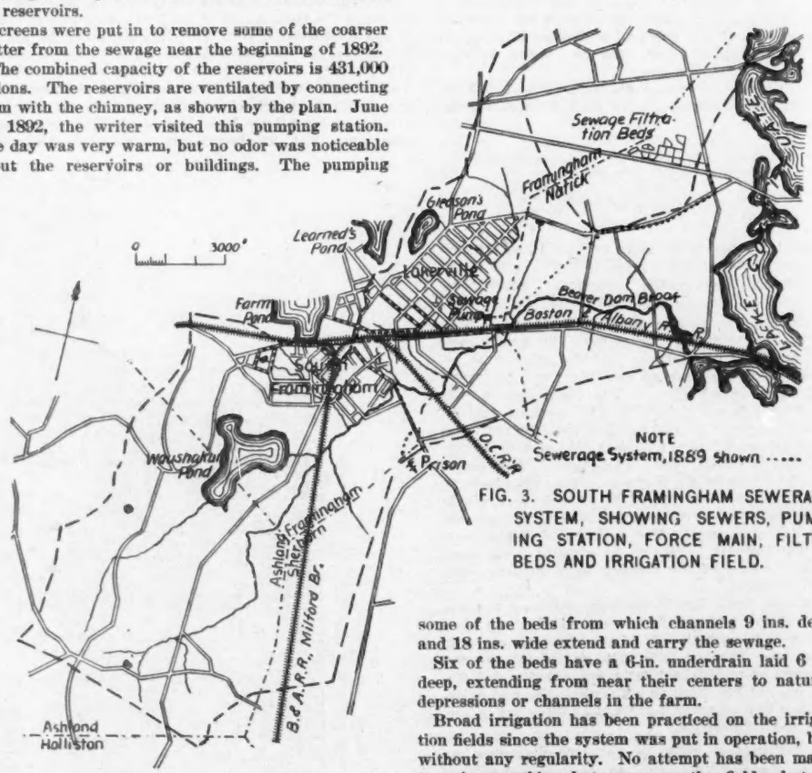


FIG. 3. SOUTH FRAMINGHAM SEWERAGE SYSTEM, SHOWING SEWERS, PUMPING STATION, FORCE MAIN, FILTER BEDS AND IRRIGATION FIELD.

Six of the beds have a 6-in. underdrain laid 6 ft. deep, extending from near their centers to natural depressions or channels in the farm.

Broad irrigation has been practiced on the irrigation fields since the system was put in operation, but without any regularity. No attempt has been made to raise anything but grass on the fields, but in June of this year there was corn on three of the filter beds and some crops were raised last year. The sewer commissioners in their report for 1891 state that they believe an income can be derived from this source in the future.

All the sewage, except the larger particles screened out this year, goes to the disposal area, there being no settling tanks for the removal of the sludge. The

surface of the uncultivated filter beds has never been touched for the purpose of working in any sludge which might have accumulated at the surface.

There has been no trouble with the filter beds during cold weather, and two winters have already passed since the system was put in operation. The sewage, it is said, creeps under the snow so that its presence would not be known so far as the eye is concerned.

As has been stated, the South Framingham plant was visited on a hot June day. There was quite a breeze. No odor was noticed on the broad irrigation area and only a faint odor on those beds which were at the time being treated with sewage. Nothing connected with the plant was in any manner offensive.

The effluent, or filtered sewage, was very clear and quite cool. A couple of mouthfuls of it were sufficient to quench the writer's thirst, but had the source of the water not been known a glass of it would have been taken with pleasure.

The following table of analyses has been kindly furnished by Mr. F. P. Stearns, M. Am. Soc. C. E., Chief Engineer of the Massachusetts State Board of Health:

Analyses of Sewage, Sewage Effluent and Unpolluted Ground Water from the Sewage Field at South Framingham, Mass. Parts in 100,000.

Color.	Total Residue on Evaporation.	Ammonia. Free.	Albuminoid.	Chlorine.
0.70	28.30	1.7893	.3750	4.07
0.00	19.45	.0335	.0039	2.56
0.00	7.23	.0000	.0029	1.77
0.00	4.70	.0000	.0008	0.20

Nitrogen as Nitrates.	Nitrites.	Remarks.
.0080	.0001	Sewage.
.6018	.0006	Sewage effluent at underdrains.
.2350	.0000	Sewage effluent at spring.
.0083	.0000	Unpolluted ground water.

Mr. Stearns' comments upon these figures and the work of the disposal area as follows:

"In each case the analyses are the averages of several determinations. They represent, first, the sewage as it flows out of the carrier upon the beds; second, the effluent flowing from underdrains beneath certain of the beds, which afterward soak into the ground and is filtered a second time before reaching the brook into which the effluent finally passes; third, the water of a spring located near the brook, which derives its supply to a large extent from the sewage effluent and represents the general character of the effluent when it reaches the brook; and, fourth, the unpolluted water from a flowing well near by.

"The efficiency of sewage filtration from a chemical standpoint is best indicated by the extent to which the nitrogen of the free and albuminoid ammonia is converted into nitrates. If, for the sake of clearness, we take these determinations from the tables, we have the following, in parts per 100,000:

	Free Ammonia.	Albuminoid Ammonia.	Nitrates.
Sewage..	1.7893	.3750	.0080
Sewage effluent at underdrains	.0335	.0039	.6018
Sewage effluent at spring..	.0000	.0029	.2350
Unpolluted ground water...	.0000	.0080	.0083

"Only a small part of the sewage effluent comes out at the underdrains and you will notice that this is purified to such an extent that there is only 2% of free ammonia and 1% of albuminoid ammonia remaining, while the nitrates have increased greatly. At the spring the free ammonia is entirely removed and the albuminoid ammonia is less than one per cent. of that in the sewage. On one occasion an analysis of the spring water showed that it contained neither free nor albuminoid ammonia, while the excess of chlorine and nitrates over the amount found in the unpolluted ground water, as shown in the last line, proves without doubt that this spring contains a large proportion of sewage effluent.

"Bacterial examinations of the sewage and of effluent collected from the spring show that nearly, if not all, bacteria are removed by filtration.

"The effluent from this sewage field flows into a small brook and although the works have been in operation more than two years the discharge of the effluent into this brook has not produced any noticeable effect."

The original cost of the whole sewerage system, as described, but with about five instead of six miles of sewers, was about $145,000. The preliminary estimate of cost was $140,000. The cost of the purification works is not given separately in the reports. The total cost of labor, fuel, improvements and repairs for the whole system in 1891 was about $6,500, of which $656 was for fuel and $3,990 for labor and services.

A cargo of 4,088 net tons of ore was recently carried from Escanaba, Mich., to South Chicago, by the steamer "Maryland," her draft being 17 ft. 4 ins. Two new boats now building are expected to carry 4,500 and 5,000 tons, respectively.

THE STOW FLEXIBLE SHAFT.

We illustrate herewith one of the newest applications of this now old and well known device which has been extensively applied to various purposes in mechanical engineering. The Stow flexible shaft, we need hardly say, consists of a spirally coiled core inclosed in a leather and wire sheath. Its form, with pulley attachment for driving, is shown in Fig. 1. In whatever position this shaft may be bent or twisted a rotary motion will be given to a drill, emery wheel or other tool fitted to the end. This shaft was invented by Mr. N. Stow, and was first used as a standard tool in dentistry. Its usefulness for general machine work was soon detected, and it is now used in almost every railway, bridge, shipbuilding and machine shop, for cases where it is desirable or necessary to take the tool to the work. In Fig. 2 is shown a center grinder, with a flexible shaft 3½ ft. long, with a friction pulley at one end, and the other attached to a sliding spindle holding a 3-in. emery wheel. The spindle turns in a tool post the same as an ordinary tool. The weight complete of this center grinder is 4 lbs. without, or 7 lbs. with, the bracket to hold the friction wheel against the cone, and the cost is $10 or $12 respectively. The company has a patent pending on an improvement in the shaft, by which its flexibility and durability will be increased, and has devised a low-speed motor for use with the shaft. The device with its various connections is manufactured by the Stow Manufacturing Co., of Binghamton, N. Y.

FIG. 1. STOW FLEXIBLE SHAFT.

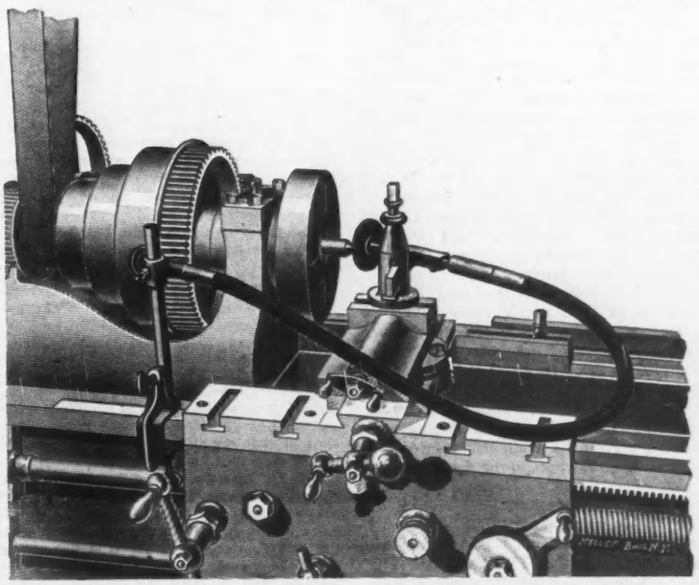


FIG. 2. STOW FLEXIBLE SHAFT APPLIED TO A CENTER GRINDER.

A NEW AND SIMPLE PROCESS OF BRIDGE DESIGNING.

Even in these busy days of progress it is not every week that we can present to our readers a genuine engineering novelty. The subject of bridge designing especially has been so thoroughly threshed over that it would seem as if most of the kernels of elementary truth must have been knocked out of it by this time. But we learn with interest, through Mr. Jas. K. Geddes, General Manager of the Bellaire, Zanesville & Cincinnati Ry., to whose kindness we are indebted for our knowledge of the new system, that no less a corporation than the Illinois Central Railroad has discovered a genius who has discovered a system which is very much simpler than any other heretofore generally used, and has very properly appointed him "Superintendent of Bridges" for its entire system. That the new method is effective as well as simple is shown by the fact that the great Cairo bridge was designed by it (if we may believe the Chicago "Tribune") and still stands up. The journal named describes the system in detail as follows:

Did you ever hear A. G. French whistle out a bridge for the Illinois Central Railroad? He has been the Superintendent of Bridges for that road for thirty years. He has grown with the system. He is the bridge architect and supervises the construction of all the road's stream-spanners. His headquarters are at Twenty-second St. station. When the road needs a new bridge French strolls into a quiet German beer saloon where there are tables and chairs and a chance to rest one's legs. He never goes into one of those Irish saloons where there's popcorn and cheese-cube lunches, no tables, chairs, not even a bar foot-rail, nothing but the bar, whisky, politics and a mad rush to consume the drinks.

Once seated he gets a glass of beer and some pretzels. They are placed on the table beside him, more as an assurance that he has them than that he will use them, for he merely sips the beer and gnaws a pretzel.

Then he whistles out the bridge.

He pulls his slouch hat over his eyes, begins drumming pensively with his finger-tips on the table, and commences whistling in a low key. Billiard balls may be clinking about him, poker chips may rattle in his ear, and the loud laughable or lugubrious din of the saloon brawlers roll around him, but the noises are in vain. He never lets up on that low whistle. There he will sit, and whistle, and think, sip beer, gnaw pretzels for from one to four hours. After this he will rise, go to his office or to a room at some hotel, lock himself in, and draw the plan of the bridge, transfer the whistled structure to paper. Then the work is

done. He seldom changes the plan from the whistled one.

The tunes he whistles vary with the bridges. The great bridge at Cairo, one of the most magnificent feats of modern mechanical engineering, he whistled out sitting in Steve Tart's saloon at Kankakee, while Ald. Ehrich, Gouger, Mellanson and Laparle were making scrambled air at the next table over a game of poker. He used "The Arkansaw Traveler" in whistling out that bridge, and as each bar of that familiar melody rose from his puckered lips up went another span of the great structure until the bridge stood entire before him; and then he hurried over to the old Illinois Central freight office and transferred it to paper.

Mr. French's peculiar method of whistling out bridges is known to all veteran officials and employes of the road. The boys say, "the bigger the bridge the faster the tune required to whistle it out." He whistled out the bridge at Kankakee, just above the dam, with a grim suggestiveness, to the tune of "Nearer, My God, to Thee." The long scraggy bridge over the bayous near New Orleans he whistled out on:

Weary gleaner, whence comest thou,
With empty hands and clouded brow?

The bridge slouches along over the lazy, heavy-eyed alligators to about the same gait as the loose-jointed tune drags its heavy feet across one's ears.

One day French sat in a saloon whistling, keeping time with his fingers and glancing over the beer foam from under his hat-brim, when in strode conductor Ed. Lynch, Dave Lavery, Fred Carignan and other veteran Illinois Central workers. What was their astonishment at hearing him whistling away for dear life on that imported English abomination, "Ta-Ra-Ra-Boom de-ay."

Lynch says: "Here, the old man has got to have some respect for the road. A bridge whistled out by that tune will draw a train load of passengers with the crew down to dusky death. We must draw the line somewhere as a matter of self-defense. Let's ask him where that bridge is to be built?"

They touched French's shoulder. He turned away from his whistle trance to them and they asked him where he would locate this last designed piece of whistle architecture, and he replied moodily:

"It's a cattle guard I'm drafting," and relapsed back into the bounding, billowy notes of the "Boom-de-ay."

NEW WATER WORKS IN GENOA, AND THEIR UTILIZATION FOR ELECTRIC TRANSMISSION OF POWER.

The new water works in Genoa, Italy, which at the same time are used to develop electric power for transmission, derive their supply from the Gorzente, a tributary of the river Po, says the "Zeitschrift des Vereines Deutscher Ingenieure," to which periodical we are indebted for the following abstract:

The two dams for the collecting reservoir, situated on the Adriatic slope, on the line between Piedmont and Liguria, were constructed in 10 years at a total cost of $700,000 approximately. The water-supply is conducted down the valley to Genoa and Nervi by a tunnel 1.243 miles long, and a water-main 74.6 miles long, furnishing from 106 to 132 gallons per second. As the elevation of the water level in the collecting reservoir is 2,050 ft. above the level of the Adriatic, the water conduits in Genoa would have been subjected to a too great pressure; on that account the Constructing Engineer, Sig. Bruno, concluded to utilize a part of the available water power, 1,600 HP. to develop electric power for transmission.

For that purpose three stations were erected on the so-called "wild mountain." The lower one, named "Galvani," developing 450 HP., was furnished with two dynamos of R. Thury's patent. The middle station, "Voltâ," was put in working order Nov., 1891. Since then the machines have been working day and night without interruption. Here three 140-HP. Faesch-Piccard turbines drive one pair each of Thury's dynamo machines, each on of the latter developing 47 amperes by 1,000 volts tension. As the six dynamos are placed behind each other, the total tension amounts to 6,000 volts. A fourth pair of dynamo machines is kept in reserve. The conduit of 16.2 miles length consists for the most part of 11-32 in. uninsulated copper wire, fastened to insulators.

The Thury electro-motors of 15 to 60 HP. have given great satisfaction. The smaller motors are used to run mills and factories, while the larger ones are employed for the lighting of the railway stations of Genoa and Sampierdarena, and the city of Genoa.

PERSONALS.

Mr. W. A. Davis has been appointed Superintenedent of Water-Works, at Montreal, Que.

Mr. Thomas Hassard, for ten years engineer in the office of the United States Commissioner of Railroads, has resigned on account of failing health.

Mr. H. H. Gladding, has been appointed Assistant City Engineer at New Haven, Conn., vice Mr. J. S. Morley, resigned.

Mr. L. E. Thompson has been appointed Superintendent of Water-Works at Dunkirk, N. Y., vice Mr. G. M. Abell, deceased.

Mr. S. W. Huston, Master Mechanic of the Cornwall R. R., has been appointed Superintenedent and Master Mechanic of the Chicago & South Side Elevated Ry., vice Mr. E. B. Wetmore, resigned.

Mr. John M. Adams, Mining Engineer, died in San Francisco, Cal., recently. He graduated at the Columbia School of Mines in 1867, and went to the Pacific Coast where he made a specialty of the treatment of gold ore.

Col. A. Wilson, formerly Chief Engineer of the Mobile & Birmingham Ry., and of the East Tennessee, Virginia & Georgia Ry., has been appointed Chief Engineer of Maintenance of Way of the Missouri, Kansas & Texas Ry.

Mr. George W. Sturtevant, Jr., Chicago, has removed his office to the Chamber of Commerce Building. He will make a specialty of hydraulic engineering and is at present engaged as engineer for the new water-works at Neenah, Wis., and West Knoxville, Tenn.

Mr. I. A. Sweigard has been appointed General Manager of the Philadelphia & Reading R. R., the appointment dating from Aug. 1. Since the election of Mr. A. A. McLeod as President in 1890, Mr. Sweigard has occupied the position of Assistant General Manager.

Col. G. H. Mendell, Corps of Engineers, U. S. A., and Prof. Geo. Davidson, Asst. Supt. of the U. S. Coast and Geodetic Survey, have been authorized by the President to make a report on improvements in the sewerage system of San Francisco. These engineers, in connection with Mr. Irving M. Scott, of the Union Iron Works at San Francisco, were requested by the mayor of the city in March last to make a report on this subject, and a petition was sent to Washington requesting official permission for the two members of the Commission in Government employ to devote the necessary time to the work.

Col. John A. Price died at Scranton, Pa., Aug. 3, at the age of 50. He was the organizer of a movement to make a permanent census as a basis of representation; also of the permanent statistical department of states for the purpose of a basis of value on which taxation may be equally distributed. He had long been interested in the utilization of the coal waste in Pennsylvania, and was chairman of the state commission appointed to look after it. He was recently appointed a Commissioner to the International Trade Congress connected with the World's Fair. He was a member of the Society of Inventors, the American Society of Mechanical Engineers, the International Geographical Society, and the American Institute of Mining Engineers.

NEW PUBLICATIONS.

AUGUST MAGAZINES.—In "The Forum," Mr. Aldace F. Walker, Chairman of the Western Traffic Association, describes the economic reasons for the existence of that organization, a subject on which he has before expressed himself, we believe, in the same magazine. He says the main difference between this association and those which have preceded it is that its power is derived from the boards of directors of the several companies, a higher source of authority than the President's even. "There is but one step higher from which authority could be derived, viz., the stockholders. And in case the directors prove unable to cope with the difficulties surrounding the reasonable regulation of railway competition, the stockholders themselves will have to undertake its solution." The two great causes of rate cutting are, first, "the eager pursuit of tonnage by traffic officers," and, second, "the persistent importunity of patrons." The law will not be enforced until public opinion demands it. At present even that part of the business community which does not break the law does not recognize the essential criminality of those who do. The question of highway improvement is discussed by Ex-Gov. Jas. A. Beaver, of Pennsylvania. He says that defective laws are the main reason why we have so few good roads, but that the bottom reason after all is that the general public is still indifferent on the subject. He does not think that complicated laws are needed, however, but says that "any simple plan which will secure the location of a road by a competent engineer, and its construction by a man who is familiar with the principles of road making, will reach the results at present desirable." Another paper in this number deserving mention is by Mr. R. H. Edmonds, late editor of "The Manufacturers' Record," on the industrial development of the South. The "Popular Science Monthly" serves a large slice of extracts from foreign journals to its readers this month. Of 13 articles, 5 are reprints from foreign periodicals or from books. Mr. Geo. A. Rich has a good description of the development of boot and shoe manufacture in this country. It is interesting to note that in 1885 the statistics collected by the Massachusetts Labor Bureau showed an average profit of 14.06% in boot and shoe manufacture against 8.13% in leather, 0.65% in cotton goods, and 5.47% in woolen goods. The greatest fortunes in the shoe industry, however, have been made through the control of patents. One Lynn manufacturer in a single year paid $15,000 royalty for the use of the McKay sole sewing machines in his shop.

In the "North American Review" Mr. F. B. Thurber combats the popular notion that business is always dull in Presidential years. He shows by statistics that the difference, if it exists, is too small to be of importance, and he prophesies a season of business activity this year notwithstanding the campaign. Major J. W. Powell has an excellent paper on "Our Recent Floods." He takes occasion to administer the following gentle rap to General Dyrenforth and his co-believers:

It is a glorious sight to see a man in possession of an idea, for the great idea exalts the man; but it is a sorry sight to see an idea in the possession of a man. Some ideas are like devil fish. They wind themselves about their victims, who writhe in agony and exclaim "How great is this idea, it is science itself." There are those who would control the rain and change the climate by boring artesian wells; there are those who would control the clouds by planting trees and preserving forests; there are those who would change the climate by building railroads, and there are those who would control the rains by bombarding the heavens with popgun balloons. When you meet with one of these men you may always know that a devil-fish has seized him.

Major Powell thinks that the increasing storage and use of water for irrigation may yet have considerable influence in checking floods, as will also improved cultivation and underdrains, which will make great areas of the soil more porous, absorbing a greater proportion of the rainfall. To prevent losses of life and property by floods he would have no house or building erected on a "torrential flood plain." On delta flood plains, elevations in the midst of the plains and artificial embankments may form safe sites for houses.

The "Century" has an interesting description of that part of Canada's Northwest Territory lying between the Rocky Mountains and Hudson Bay. In the series of papers by Emilio Castelar, on Christopher Columbus, this number graphically describes the great voyage. It may be news to many to learn that the start on this momentous voyage was made on a Friday. Two of the papers in the literary magazines this month are on "Ice," a most appropriate topic for the season. In "Harper's" Dr. T. Mitchell Prudden, the bacteriologist, writes on "Ice and Ice-Making," treating the subject from the standpoint of the chemist and microscopist, and discussing at length the crystallization of ice. Of the use of impure ice in New York City, he says:

We know that typhoid fever is nearly always present in Troy and Albany during the ice-harvesting season. We know that the typhoid fever germ resists freezing and long continued cold; and yet between 700,000 and 800,000 tons of ice are cut from the Hudson in average years within twelve miles of Albany.

"Scribner's" paper on Ice is by Prof. N. S. Shaler, and describes ice in the form of icebergs and ice floes. The climate of Northern Europe, of Northeastern America, and of the southern extremity of South America, is considerably colder than it otherwise would be on account of the number of icebergs in the adjacent seas. The last of the paper is devoted to the risk to Atlantic steamers due to icebergs. After discussing the proposal to send men-of-war to break up icebergs with heavy shot, he concludes that it is impracticable. The only way to prevent accidents from icebergs is for vessels crossing the Atlantic to take the longer southern course during the period when icebergs are likely to be found in the usual track. Another paper in this number is one of great interest in the "Historic Moment" series. The late Sidney Dillon tells how the last spike was driven in the first transcontinental railroad, the Union Pacific. The great event occurred at Promontory, Utah, on May 10, 1869. One thing in the paper which surprises the younger generation of men is that the chief object of all early projectors of transcontinental railways was not the development of the country or even connection with California, but was the promotion of Asiatic trade. Those were the days, however, when the nation's foreign commerce engaged a large share of its activities. One article further in "Scribner's" deserves a word of comment. It is that in which a young man describes how he sent his aunt to Baltimore, with a ticket for Philadelphia, and minus her trunk check and purse. The outcome of the scrape was that the Division Superintendent came to the young man's relief by tele-

graphing to the conductor and baggage master, making everything all right. Doubtless most railroad superintendents who read this will fervently hope that appeals to the superintendents' office by the large percentage of travelers who blunder as they go will not be encouraged by this publication. We fear that on many roads the heedless youth who is supposed to tell the story, would not meet with such cordiality from the superintendent, free gratis, as he claims in this case to have received.

POOR'S MANUAL OF RAILROADS.—The 25th Annual Number, Including Poor's Directory of Railway Officials. New York, 1892: H. V. & H. W. Poor. 8vo. pp. 1208+226; with maps.

A very full discussion of the advance sheets of the introduction to this volume was given in our issue of July 28.

THE COMPASS.—A Monthly Journal for Engineers, Surveyors, Architects, Draftsmen and Students. Vol. 1, 1891-92. Wm Cox, Editor. New York: Keuffel & Esser Co. 8vo., pp. 192. $1.75.

This is the first volume complete of a monthly publication which we have already had occasion to notice favorably. Typographically it is exceedingly neat, even luxurious. The editor is a well known mathematical expert, who has been a frequent and valued contributor to Eng. News, and who has contributed to this volume a number of original and interesting articles on speedy calculations, graphical and mechanical, useful series of numbers and the like, as well as a new and complete gradienter table which alone will make the volume useful to many. All the latest improvements in mathematical and surveying instruments are also described in it.

THE RAILROAD ENGINEER'S PRACTICE.—Being a Short but Complete Description of the Duties of the Young Engineer in Preliminary and Location Surveys and in Construction. Fourth edition, revised and enlarged. By Thos M. Cleeman, A. M., C. E. New York: D. Van Nostrand Co. 12mo., pp. 190. About 50 illustrations. $2.00.

After being out of print for several years, a new and enlarged edition of this useful and practical manual, formerly published by this journal, has been undertaken by its present publishers. While the additions have been considerable in the aggregate, they are scattered throughout the work and are not such as to change essentially its nature, but only to make it still more useful. What we and the public thought of it is indicated by the fact noted, that we originally published it and sold off every copy printed long ago. We can hartily commend it to young engineers as a useful and instructive work, though it is hardly as complete as its title asserts, and hence will not take the place of other more elaborate works, published and to be published.

ELEMENTS OF MACHINE DESIGN.—Notes and Plates, for the Use of Students in Lehigh University. By J. F. Klein, Prof. Mech. Eng. Second and revised edition. Bethlehem, Pa.: Moravian Publication Office. 8vo., pp. 212, 9 large tables, 14 plates of details. $6.00.

This second edition is a decided improvement on the first, which we noticed favorably when published. The plates, which were a weak point of the former edition, are decidedly improved, both in quality and quantity.

The volume does not profess to be a complete treatise, and is confined wholly to the details of fastenings, bearings, rotating parts, and gearing. It strikes us as an admirable basis for a thorough course of instruction in the design of such details, which is such a profitable part of the course of instruction at all our good schools of mechanical engineering. Among the fastenings considered are screw threads, bolts and nuts, all forms of rivet joints, gibs, keys and cotters. This part of the work occupies 91 pages. The great subjects of toothed and belt gearing occupy the next 45 pages, and the remaining 76 pages are devoted to the designing of rotating parts, bearings and rods. The work ought to be a useful book of reference to the mechanical engineer as well as text-book for the student, the only drawback to it being that, for a confessedly "incomplete" treatise, its price is pretty high. A complete index and elaborate set of gear tables close the volume, in which we see much to commend and very little to criticize.

STREET RAILWAYS.—Their Construction, Operation and Maintenance; a Practical Handbook for Street Railway Men; by C. B. Fairchild, Editor of the Street Railway Journal. New York, the Street Railway Publishing Co.; 4to cloth, pp. 486; copiously illustrated; $4.

That the first chapter of a treatise on street railways should be devoted to electric traction is perfectly proper now, since that system has won its way into far greater favor than any other.

The present volume devotes 80 pages to electric traction, 63 pages to cable traction, 32 pages to horse traction and 15 pages to steam, air and gas motors, an allotment of space which quite fairly represents the relative importance of the several systems at the present time. There are also chapters on elevated roads, inclined planes, rack rail inclines, car building, track construction, discipline and rules, bookkeeping, and forms for franchises and securities. The book is a reprint of a series of articles which have been published in the "Street Railway Journal," and is as well up to the latest and best practice as can be expected in an industry which is developing and changing so rapidly as is street railway operation. The author, as a rule, contents himself with describing actual practice, selecting as many illustrations as possible from works actually built and avoiding comment or criticisms upon them.

DYNAMOMETERS AND THE MEASUREMENT OF POWER.—A Treatise on the Construction and Application of Dynamometers; with a Description of the Methods and Apparatus Employed in Measuring Water-Power. By John J. Flather, Ph.B., M.M.E., Prof. Mech. Eng., Purdue University. 12mo., pp. 215; 17 engravings, 11 tables. $2.00. New York: John Wiley & Sons.

It gives one an unpleasant and somewhat disgusted feeling to see an author describe himself on his title page, as does Prof. Flather, as the "Author of the American Edition of Wilson's Steam Boilers." At best it indicates a loose sense of the meaning of words, which augurs ill for the perspicuity of anything he may write. How can a man be the "author" of a mere supplementary "edition"? At best he can be but an editor, and should so describe himself.

But the unfavorable impression produced by such a slip as this is largely dissipated by an examination of the work itself, which is an excellent, careful and quite complete treatise on its subject.

The aim of the work, of course, is to present in convenient form a description of the construction and principles of action of all the various types of dynamometer now used for the measurement of power. The author says in his preface:

A chronological presentation of the subject has not been attempted, as many of the forms once used have entirely disappeared. With very few exceptions the various types discussed are those now in use. In the measurement of the mechanical horse-power of a hydraulic motor the effective power may be ascertained by means of a friction-brake, or other dynamometer, under any given conditions; but as these may be such that the maximum power of the wheel is not developed, it remains for the engineer to determine those conditions best suited to the wheel under consideration. In Chapter VI. is given a discussion of the methods and apparatus in use for ascertaining the efficiency of a given wheel, including the determination of flow in rivers and streams.

Chapters I. and V. of the work are devoted to the determination of the amount of power needed for given uses. Chapters II., III. and IV. are devoted respectively to very good descriptions of all the several types of friction brakes, absorption dynamometers and transmission dynamometers. Chapter VI. is devoted to water power measurements. Typographically the work is especially commendable, though some of the engravings are not what they should be. The work should be useful to many engineers.

RAILWAY CAR CONSTRUCTION.—A Work Describing in Detail and Illustrating with Scale Drawings The Different Varieties of American Cars as Now Built.—By William Voss. New York: R. M. Van Arsdale. Small 4to., pp. 177; about 300 engravings. $3.00.

With the partial exception of the Car-Builders' Dictionary, this is the only book in existence purporting to occupy its field by describing in detail the practical construction of American cars. It would therefore have to be poor indeed if it did not "fill a void" and constitute a useful addition to railway literature. But it is not poor. On the contrary, it is clearly and concisely written, and in the main sufficiently complete. The author is an experienced master car-builder, formerly M. C. B. of the Burlington, Cedar Rapids & Northern Ry., and began the preparation of this work four or five years ago in the form of a series of articles for the "National Car and Locomotive Builder." This mode of publication has enabled revisions to be made wherever necessary, and the result is a very excellent and creditable treatise on its subject.

The author adopted the correct plan in deciding to take up the several parts of a car in succession, and discuss the various designs for it together, rather than to describe in succession complete cars as built by different companies. In this way he consolidates into single chapters of a few pages each all that he has to say about car bodies, draw gear, floors and framing, sheathing and roofs, doors, stock car bodies, freight car trucks, brake gear, and so on, for some 26 chapters in all. Appended to the volume, and occupying the 18 closing pages appear the several M. C. B. standards in full, and the last code of rules for interchange of freight cars.

The aim and practice of the author was rather to chronicle facts than to advance theories, or to criticise the practice of others. Therefore the work can fairly be criticised only for misstatements or omissions of important facts. Omissions in plenty there are without doubt, but hardly important omissions in view of the plan of the author. It goes without saying that a book of this size, covering in a few pages the entire subject of car construction, both freight and passenger, cannot pretend to be complete. A work of twenty times its size could hardly be made so. The subject of freight draw gear alone could not be treated exhaustively within its space; but then, there would be no great gain in making the attempt. There are hosts of facts in relation to special forms of design which we should be glad to be able to find in the work if we had occasion to look them up, but which are not here, and some of them it would seem should be here, especially in respect to draw gear and brake gear. But so far as we have observed, the more generally approved and adopted methods of construction are given in every case, with many of the less common and approved designs. As this was all which the author set out to do, and as this he has done very well, it would be unreasonable to criticise him for the remaining omissions. What he has given is almost always well chosen, and what he has said is very rarely indeed open to criticism as unsound.

TRADE PUBLICATIONS.

FLUSH TANKS.—B. Van Vranken, Schenectady, N. Y. 8vo., pp. 23, illustrated.

This pamphlet contains a description of the Van Vranken flush tank, with tables of sewer discharge, weights of material, number of brick in sewers, cubic capacity of ditches, and other convenient tables of information for engineers.

ROPE TRANSMISSION OF POWER.—Link Belt Machinery Co., Chicago, Ill. 8vo., pp. 16, illustrated.

This pamphlet describes manila rope power transmission as applied by the company, and points out the advantage of this system. The illustrations show its application for driving dynamos, factory plant, elevators, etc.

GRADING PLANT.—F. C. Austin Mfg. Co., Chicago, Ill. 4to., pp. 80; illustrated.

This is a well got up and very fully illustrated catalogue of the new Era railway and road graders, wagon loaders, ditching machines, Austin steel reversible road machines. It includes also wheel and drag scrapers, plows and earth handling tools of all kinds, dump wagons, road rollers, rock crushers, street sweepers and well driving plant. It contains also descriptions of the machines and their method of operation for railway, road, levee, ditch, sidehill and wagon work, with excavation diagrams, comparative cost of wagon loading, and novel valuable information for engineers and those interested in the moving of earth. There are also a number of testimonials.

SOCIETY PROCEEDINGS.

SOUTHERN AND SOUTHWESTERN RAILROAD CLUB.—The next meeting will be Aug. 18, at the Kimball House, Atlanta, Ga. The subjects for discussion will be as follows: 1, "Joint Inspection;" 2, "Charges for Wrong Material in Freight Car Repairs;" 3, "Locomotive Cylinders, the Effect of Wear from Packing, Best Style of Packing Ring where Economy of First Cost is Considered." The experience of those using 18-in. cylinders or over is especially desired. The following committees are expected to make reports: W. H. Thomas and Pulaski Leeds, "Repair Work on Large Systems and Location of Plants for Same;" Pulaski Leeds, A. W. Gibbs and Wm. Garstang, "The Most Suitable Form of Performance Sheet for General Use."

S. A. Charpiot, Secy.

COMING TECHNICAL MEETINGS.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Aug. 18. At Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Aug. 18. Secy., C. F. Franson, 113 Adams St.
ENGINEERS' CLUB OF CINCINNATI.
Aug. 18, Secy., J. F. Wilson.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Aug. 20. Secy., F. D. Jones, Helena.
NEW ENGLAND ROADMASTERS' ASSOCIATION.
Aug. 24, 25. Springfield, Mass. Secy., G. L. E. French, Northampton, Mass.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Sept. 2. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Sept. 2. Secy., O. von Geldern, 819 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
Sept. 3. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
NORTHWEST RAILROAD CLUB.
Sept. 3. Union Station, St. Paul.
ENGINEERS' CLUB OF PHILADELPHIA.
Sept. 3. 1122 Girard St. Secy., L. F. Rondinella.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 7. Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Sept. 8. Secy., Edward Mead, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTHWEST.
Sept. 8. Secy., O. H. Landreth, Nashville, Tenn.
WISCONSIN POLYTECHNIC SOCIETY.
Sept. 12. Loan & Trust Bldg., Milwaukee. Secy., M. G. Shinke.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Sept. 12. Secy., C. L. Annan.
DENVER SOCIETY OF CIVIL ENGINEERS.
Sept. 13. Secy., Geo. H. Angell.
WESTERN RAILWAY CLUB.
Sept. 20. Rookery Building, Chicago. Secy., W. H. Marshal.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Sept. 20. Secy., R. N. Clark, Pittsburg, Pa.
ENGINEERS' CLUB OF ST. LOUIS.
Sept. 21. Secy., Arthur Thacher, Odd Fellows' Building.
CENTRAL RAILWAY CLUB OF BUFFALO.
Sept 28. Secy., Jas. Macbeth.
ROADMASTERS' ASSOCIATION OF AMERICA.
Oct. 18. Chattanooga, Tenn. Oct. 19, Atlanta, Ga. Secy., J. H. K. Burgwin, Grand Rapids, Mich.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 19, 20, 21. Cleveland, O. Secy., Wm. J. Richards Brooklyn, N. Y.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York. Entered at the Post Office, New York City, as Second Class Matter.

VOL. XXVIII. THURSDAY, AUGUST 11, 1892.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS

CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS

GEO. H. FROST.....BUSINESS MANAGER

SUBSCRIPTION RATES: one year, $5.00; 6 months $2.50; 4 months, $2.00; single copies, 15 cents. To all foreign countries in the Postal Union, add $2.00 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses. No club rates allowed.

The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES, 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

It is well known that the sudden drop in Atlantic records which occurred about three years ago was due to the building of a new type of vessels, propelled by twin screws, driven by independent engines. Great as are the advantages of this plan of construction, however, in the securing of the ship against accidents and delays, it is probable that a single large engine develops its power with less loss and that a single screw exerts a greater proportion of the energy imparted to it in driving the vessel than does any arrangement of double or triple screws. It is an interesting bit of evidence on this point that the "Umbria" of the Cunard line has just made a passage from Queenstown to New York in less than six days; her time being 5 d. 22 h. 5 min.—just four hours better than her best previous record, made last January. This is only a little over six hours slower than the best record, recently made by the "City of Paris." It is, we believe, the first time that a single screw steamer has made the passage in less than six days. One probable reason for the excellent time is that the vessel has just been in drydock, where her machinery was overhauled and her bottom was scraped and painted. It is possible that an Atlantic greyhound may yet be built with a single great engine, driving one large screw, which will distance all its rivals. It is not at all probable, however, that the great gain in safety, due to the provision of duplicate engines and propellers, and the greater convenience of construction and repair of smaller engines, shafting, etc., will be generally given up for the sake of a small economy in power.

What the future has in store for the "arid region" of the United States has been shown in an impressive and remarkable manner by the results which have followed the drying up of the large temporary lake formed in the Colorado desert by the overflow of the Colorado River. The Madera, Cal., "Mercury" thus describes them:

> Last year the mystery of Salton Lake attracted the attention and wonder of the state, until its source was found in a break in the river bank. This year a phenomenon not less wonderful is to be seen in the same region. The desert has been transformed. The bare sands that have made the region terrible to travelers and stockmen have given place to verdure. Underbrush has covered the country in the line of the inundation, and where only the hardiest of desert plants could before maintain a precarious struggle for existence, luxuriant vegetation now covers the land.
>
> The desert is doomed. Its disappearance may not be seen by this generation or the next, yet the time is coming when orchards and fields will cover the thousands of square miles now given over to desolation. The infrequent desert plant and the occasional buzzard will give way to all the products of the tropical and semi-tropical lands that its position is fit to raise.
>
> The day may come when the present Colorado desert will be reckoned among the most productive land in California. There was a time when the plains of Kern and Tulare were held but little more in esteem than is the desert of to-day. The magic power of irrigation has transformed the old alkali plains into a garden, and it will do as much for the dreaded Colorado desert.

The Canadian race problem would appear from a recent Canadian census bulletin to be in a fair way of settling itself by an excess of emigration of French Canadians to the United States. The percentage of French-speaking population decreased slightly even during the decade 1881-1891, and if recent reports of wholesale French emigration are true should decrease still more rapidly hereafter. The percentage of various races in 1881 and 1891 may be briefly expressed as follows:

	1881.	1891.
Native French Canadians	25.8	25.4
" other "	60.0	61.1
Natives of Britain and her other colonies	11.1	10.3
" " United States	1.8	1.7
" " European countries	0.9	1.1
All others	0.4	0.4
	100.0	100.0

It will be seen that the total percentage of foreign-born (using that term in the geographical and not political sense) decreased from 14.2 to 13.5%, but that the native-born English-speaking Canadians increased from 60 to 61.1%, while the French-speaking decreased 0.4%. The natives of Ireland alone decreased from 4.3 to 3.1% of the whole population. It is a curious fact, however, that although the French Canadians and Irish together number only 28.5% of the population, against 30.1% in 1881, yet that the Catholics number 41.46% of the total population, against 41.43% in 1881, indicating that the Catholic religion has a strong and increasing hold upon the English-speaking population as well. The entire population of 4,800,511 (omitting some 30,000 population not yet accurately returned, is divided as follows:

French Canadians (nearly all Catholics)	1,415,090
Born in Ireland " " "	148,842
Other Catholics (English speaking)	426,533
Total Catholics	1,990,465
Total non-Catholics	2,810,046

In a country where religious questions enter so largely into politics, and where there is so much politics to the square inch as in Canada, these facts become important factors in the industrial progress of that country.

In our issue of July 7, 1892, we reprinted from the "Marine Review" the facts concerning the removal of Col. Wm. Ludlow and Commander O. F. Heyerman, from their respective positions as Engineer and Inspector of the Eleventh Lighthouse District. As our readers will doubtless recall, Col. Ludlow urged on the Lighthouse Board that the lighting of the St. Mary's River be carried out on a revised plan submitted by him, conforming with the necessities of navigation, and not on the original crudely drawn plan, which was so designed as actually to lead vessels on the rocks. We are much pleased to learn that at a recent meeting of the Board the plan of Col. Ludlow was approved, and Gen. O. M. Poe, who is in temporary charge of the work, was instructed to put the lights prepared by Col. Ludlow in operation.

A pamphlet has been issued by the two officers relieved, giving a statement of the course pursued by them, with copies of the correspondence between them and the Lighthouse Board. A careful examination of this correspondence must convince anyone that the only charge which can fairly be made against the two officers is that their zeal to perform an important work in the best possible manner, exceeded their attention to the red tape modes of procedure which hamper all Government work. They were by no means unobservant of the official forms and routine, however; and we see no trace of insubordination or disrespect in their communications to their superior officers. That their successive attempts to place before the Board the actual state of affairs at the Sault, was misconstrued as obstinacy and disregard of orders, seems exceedingly strange. It is exceedingly easy to cast a cloud over the reputation of any man, and exceedingly difficult to remove it. It is no more than Col. Ludlow's due to say that according to his statement of the case we do not see how he could honorably have pursued any different course. It can hardly be doubted that since the Lighthouse Board has approved the revised plan of lighting prepared by Col. Ludlow, the reinstatement of the two officers will follow at once.

An eight-hour law of far-reaching importance is about to go into force, having been passed by Congress in its expiring hours, which has hardly attracted the attention which it deserves, outside of the small circle of Government contractors, where it has attracted attention enough. It prohibits absolutely more than eight hours work in any one day on any Government work, contract or other, except in case of "extraordinary emergency," of which the Government is to be the judge. As much Government work is done by contractors who have much private work going on at the same time, and as nearly all Government work is done in the immediate vicinity of similar private work, the influence of this stringent law everywhere will be very strong.

That such a change will add greatly to the cost of Government work, and of private work, also, it it comes under the same rule, goes without saying; but it is a notable fact that in England, where the workingman is supposed to have so much harder time than here, and not without reason, the eight hour movement has gone farther and faster than here, and is practically the rule in all the engineering trades. We question greatly whether there is not considerable gain with this loss, and are not disposed to regret the change overmuch. Beyond all doubt it is giving a workman a much easier life than the manager; but then, he does not get so much, and needs some compensation if he is to hold up his head as a man and a brother.

CAR SILL REPAIRS AND GENERAL AVERAGES.

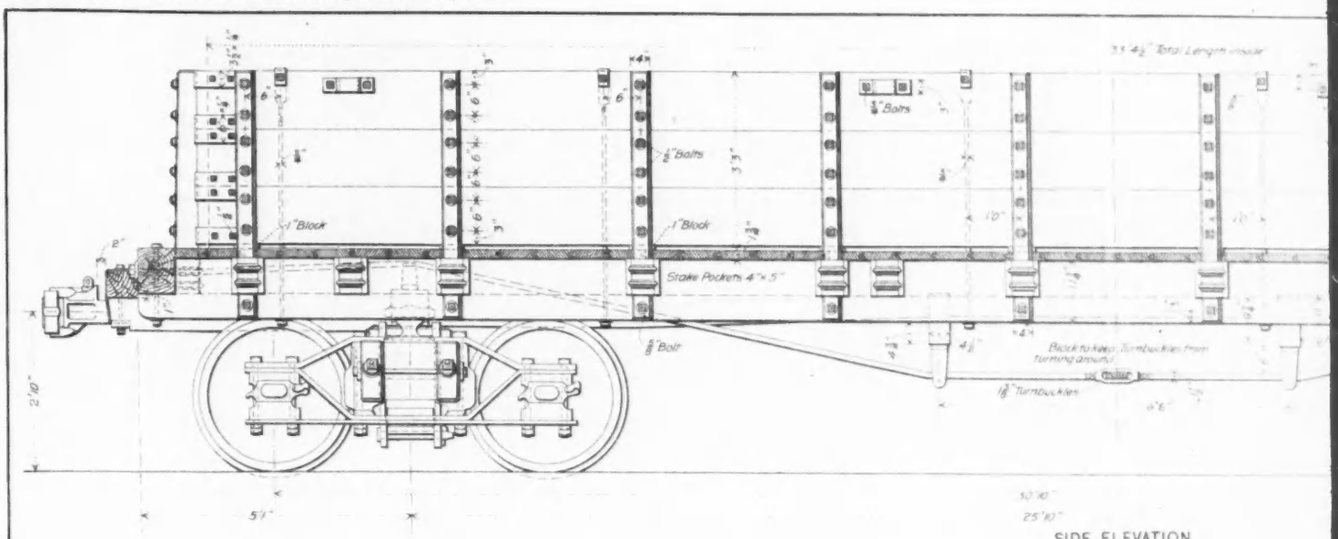
At the last Master Car Builders' Convention there was a new addition made to the so-called "interchange rules." Instead of leaving each company free to charge every other company whatever it chose to certify to as the labor charge for making certain repairs on freight cars, a specific schedule was adopted permitting a fixed number of hours of labor at 20 cts. per hour, and no more, to be charged for a long list of specified repairs. The list was printed in full in our reports of the convention proceedings, but as it is not very long we reprint the part which most concerns us and which is the principal part of this list, viz., the charge allowed for all possible cases of replacing sills. There being (ordinarily) six sills under a freight car, the number to be renewed may vary from one to six in all, and these may be distributed in a variety of ways (26 in all) between the side sills, intermediate sills and center sills, of which there are two of each:

This entire list of allowances, it was understood, was made up from the time allowances under the piecework system on the lines of the Pennsylvania Railroad, and these latter have been determined by gradual development from the results of actual experience in making repairs. The first glance at the miscellaneous list just given indicates, what careful examination makes certain, that the list is nothing but an average of actual time records for making the several classes of repairs, with perhaps an occasional interpolation.

Reclassifying this list according to number of sills replaced, and considering for the present only the non-refrigerator cars, there are:

3 cases of 1 sill replaced, chargeable at 29, 38, and 40 hours.
6 cases of 2 sills replaced, chargeable at 36, 44, 48, 53 and (2) at 54 hours.
7 cases of 3 sills replaced, chargeable at 50, 53, 58, 60, 61 (2), and 79 hours.
6 cases of 4 sills replaced, chargeable at 63, 66, 67, 74, 75 and 83 hours.
3 cases of 5 sills replaced, chargeable at 81 (2), and 89 hours.
1 case of 6 sills replaced, chargeable at 94 hours.

As these charges were deduced from thousands of records of car repairs made by many different men at many different points on many different styles of cars, we have had the curiosity to analyze them to see if they approximated at all to any simple and general law, with results which seem to us both curious and useful. They are a quite lawless series if exact values only be considered, and yet, with two quite erratic exceptions, which are plainly due to errors in the scale, they all approximate closely to a very simple law or general formula; so closely that we can feel no doubt that the law gives a fairer average for each particular charge than that which has



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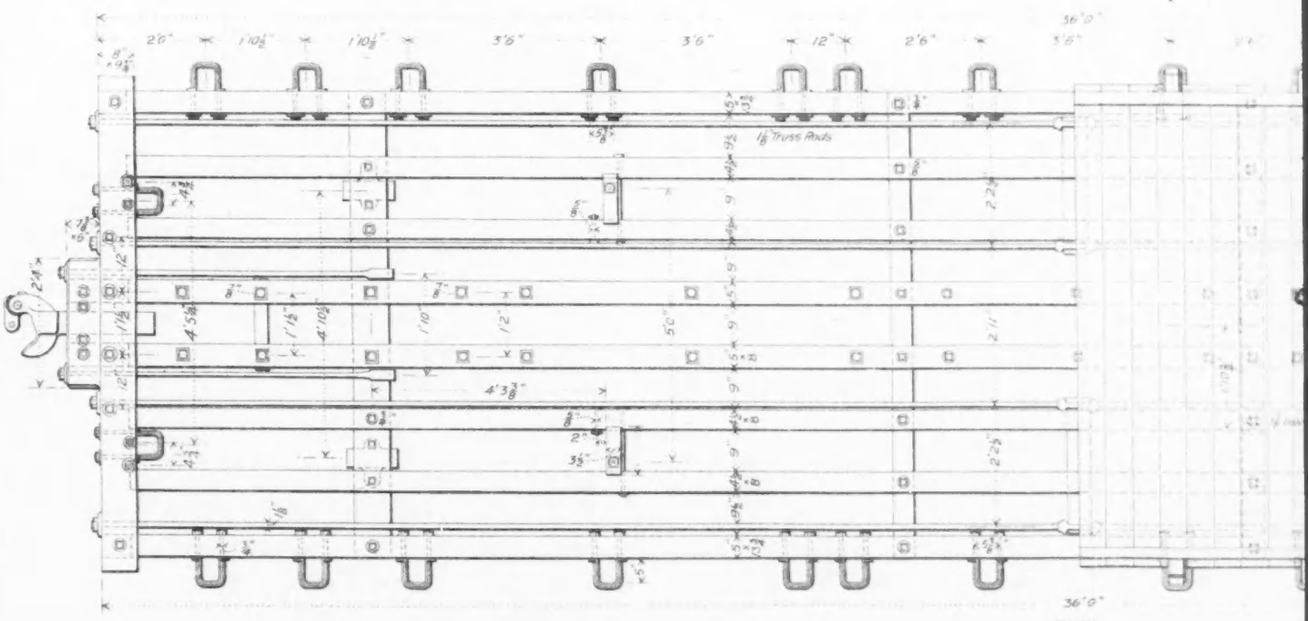

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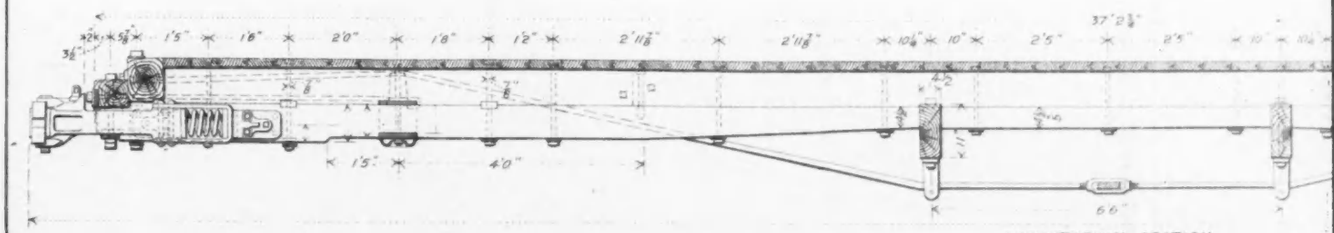

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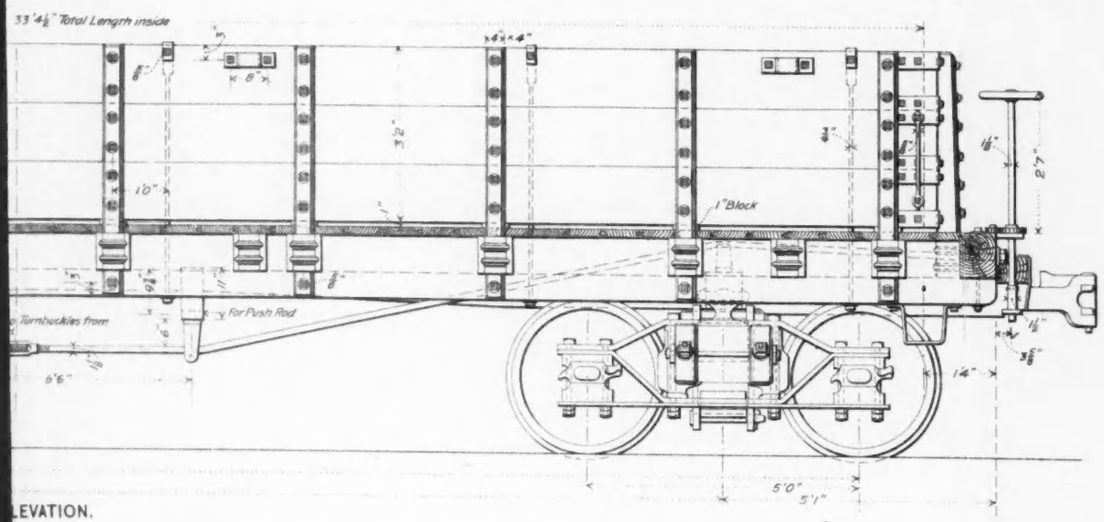

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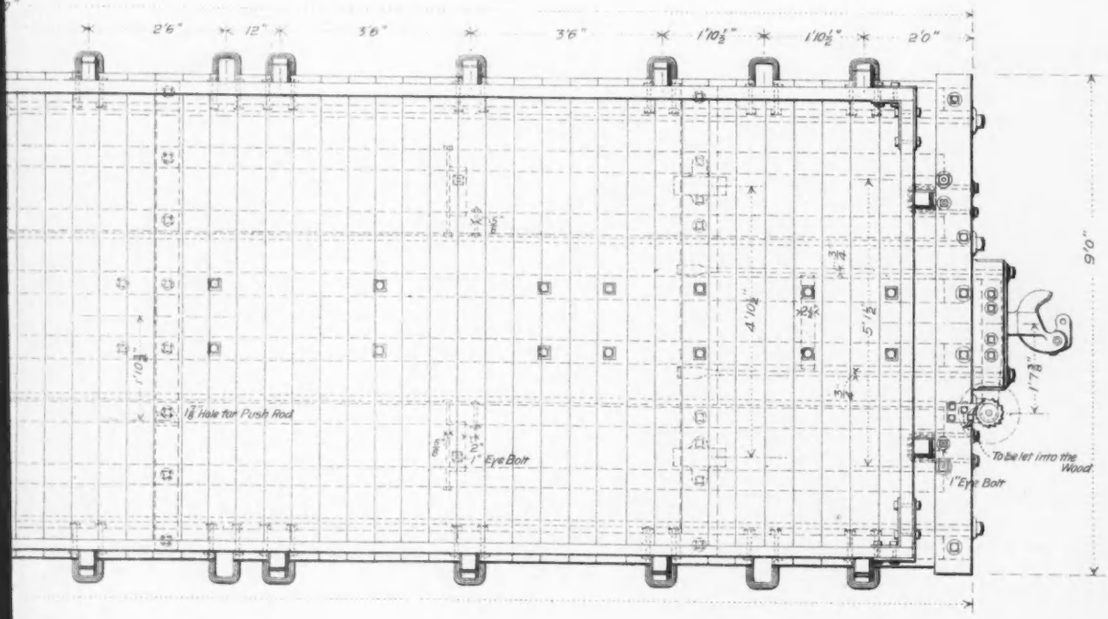

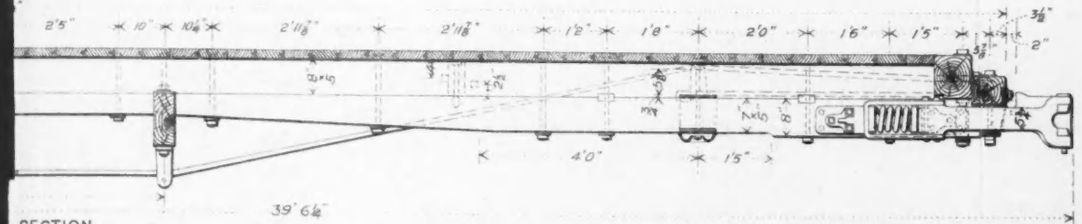

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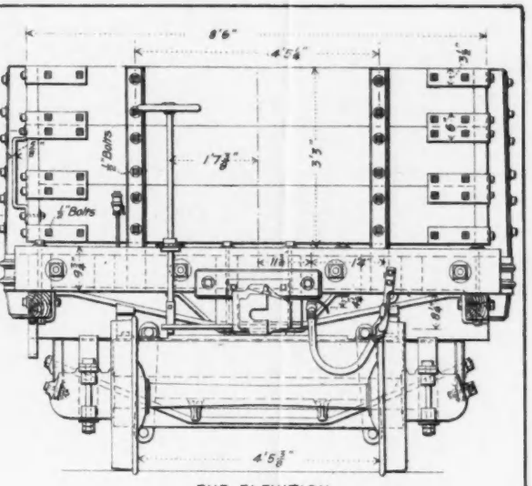
CHICAGO

Superintende



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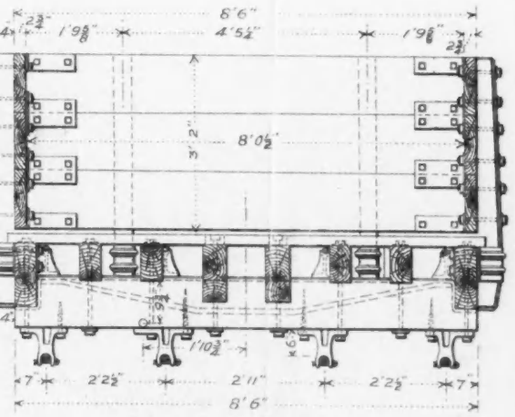


TRANSVERSE SECTION.

STANDARD COAL CAR;

HICAGO, ROCK ISLAND & PACIFIC RY.

Geo. F. Wilson,

erintendent of Motive Power and Equipment.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

been deduced from the average of actual records. This is true both for the refrigerator cars and the "all other" cars, as will be seen. If expressed in the form of an interchange rule, this law would read as follows:

The labor charge for replacing sills of refrigerator cars may be 16 hours for each side-sill, 12 hours for each intermediate sill and 18 hours for each center sill, plus an arbitrary charge of 30 hours in each case, regardless of the number of sills replaced. For replacing sills of all other cars the labor charge may be 14 hours for each side sill, 5 hours for each intermediate sill, and 16 hours for each center sill, plus an arbitrary charge of 25 hours in each case, regardless of the number of sills replaced.

The following (Table 1) shows the number of hours which may be charged for labor in doing the various items of work enumerated, which include all work necessary to complete each item of repairs, except in so far as labor is already included in charges for materials:

Table 1.

	Refrigerator cars.	All other cars.
1 side sill, replaced	44	38
2 " sills, "	63	53
1 " sill and 1 intermediate sill, replaced	50	44
1 " " " 2 " sills, "	60	50
2 " sills " 1 " sill, "	72	58
2 " " " 2 " sills, "	81	63
1 center sill, replaced	44	40
2 " sills, "	70	54
1 side sill and 1 center sill, replaced	70	54
1 " " " 2 " sills, "	93	79
2 " sills " 1 " sill, "	77	60
2 " " " 2 " sills, "	104	83
1 inter. sill, replaced	40	29
2 " sills, "	54	36
1 " sill and 1 center sill, replaced	65	48
1 " " " 2 " sills, "	78	61
2 " sills " 1 " sill, "	71	53
2 " " " 2 " sills, "	88	66
1 side sill, 1 intermediate sill and 1 center sill, replaced	79	61
2 " sills,1 " " 1 " " "	100	75
1 " sill, 2 " sills, " 1 " " "	92	67
2 " sills,2 " " 1 " " "	107	81
1 " sill, 1 " sill, " 2 " " "	96	74
2 " sills,1 " " 2 " " "	110	80
1 " sill, 2 " sills, " 2 " " "	106	81
2 " sills,2 " " 2 " " "	120	94
1 " sill, spliced	15	12
1 int. "	14	11

(The remaining 18 items of the list refer to other kinds of repairs, and do not concern us.)

How closely these general rules agree with the empirically established charges is evident at once from the following Table 2, in which the several cases are rearranged in classes according to the number of sills removed. In the first three columns of the table the asterisks (*) indicate the number of sills of each kind removed, and the dots (.) the sills not removed. At the top of each of these columns is given in parenthesis the number of hours chargeable by our rule for each sill removed, and the sum of these charges +25 gives the time charge in the fourth column, which is contrasted with the M. C. B. time charge, given in the next column. The last column gives the excess (+) or deficit (—) of our rule from the M. C. B. allowance. At the right of the last column is given the algebraic sum of the variations for each group, and (at the bottom) the algebraic sum of the variations for the entire 26 cases, which is only +4 hours for an aggregate of 1,591 hours of time allowance, or only a quarter of 1%.

Table 2.—Sill Renewals of Freight Cars Other than Refrigerator Cars.

(Sills taken out starred; sills left in dotted.)

	Side. (14)	Interm. (5)	Center. (16)	Time allowances in hours. M.C.B.	By our rule.	Excess by our rule.	
1	**	**	**	94	95	+1	+1
2	**	**	*.	81	79	-2	
3	**	*.	**	89	90	+1	
4	*.	**	**	81	81	0	-1
5	**	**	..	63	63	0	
6	**	..	**	83	85	+2	
7	..	**	**	66	67	+1	
8	**	*.	*.	75	74	-1	
9	*.	**	**	74	76	+2	
10	*.	*.	*.	67	65	-2	+2
11	**	*.	..	58	58	0	
12	**	..	*.	60	69	+9	
13	*.	**	..	50	49	-1	
14	*.	..	**	79	71	-8	
15	..	*.	**	61	62	+1	
16	..	**	*.	53	51	-2	
17	*.	*.	*.	61	60	-1	-2
18	**	**	..	53	53	0	
19	..	**	..	36	35	-1	
20	..	..	**	54	57	+3	
21	*.	*.	..	44	44	0	
22	..	*.	*.	48	46	-2	
23	*.	..	*.	54	55	+1	+1
24	*.	..	..	38	39	+1	
25	..	*.	..	29	30	+1	
26	..	..	*.	40	41	+1	+3
Total of 26 items.				1,591	1,595		+4

In the entire list of 26 cases there are only two near the middle of the table (cases 12 and 14; 2 side sills, 1 center sill; 1 side sill, 2 center sills) which vary more than 3 hours from the M. C. B. list. Brief examination of these allowances in comparison with the others of the table will reveal at once that these two specially large errors are due to disproportionate charges in the M. C. B. schedule, but as the errors are compensatory, they were not likely to cause complaint, the men making as much by the one as they lost by the other. There is only one other case in which the difference is so much as 3; only six cases in which the difference is so much as 2 (four —, two +); twelve cases in which the difference is 1 (eight +, four —), and five cases in which there is no difference. The agreement is not only close in the aggregate and for each separate example, but is still closer for the separate groups of equal numbers of sills removed, as shown at the extreme right of the table.

So remarkably close is the agreement that one is almost disposed to suspect that it was made out under some general rule such as we have suggested, instead of independently, item by item, according to the average of many records of time spent on each. One would hardly expect to find the time spent in sill removals following so closely such a simple law. But to see that this was not the case we have only to test the column for refrigerator car repairs in Table 1 in a similar way.

Refrigerator cars are, in the first place, a comparatively new innovation, and, secondly, are very much fewer in number than other freight cars. Therefore the number of actual records of refrigerator car sill repairs must be very much fewer than for "other" freight cars, perhaps not more than 2 to 5%. Hence, if the lists were made up in part or whole by some general formula we should expect to find even fewer irregularities in the refrigerator car list than in the list we have already analyzed, because there are fewer records of experience to cause modifications in it. On the other hand, if made up independently from experience records only we should expect to find it approximate to such general law as do the "other" cars, but with many more, and more erratic exceptions.

This last we find to be the case. Table 3 exhibits the nearest approximation we have been able to make to a general formula giving the same mean results as the M. C. B. table. It will be seen that the mean error is very much greater than in Table 2, there being no less than 11 out of the 26 cases in which the error is greater than 3, which was the maximum error of Table 2 (barring two plainly erratic exceptions) and only occurred once. It is plain from the distribution of the errors in Table 3, moreover, that no modification of the formula can possibly be made which will materially reduce the aggregate of errors; they are too erratically distributed. Their algebraic sum is only 12 in 2,034, as it is, against 4 in 1,591, but the numerical aggregate of the errors, disregarding their sign, is 94 against 28.*

Do not these facts prove that a fairer average would be struck in both cases by disregarding the present arbitrary list of time allowances and substituting those of our two suggested formulas? It seems to us so. In any case it was reasonable to expect that there should be some sort of a natural law of variation in the time required for these sill repairs, and the two tables furnish a curious example of unconscious approximation to such a law. Let experience with refrigerator cars continue long enough and we cannot doubt that by gradual emendations the list would finally assume as symmetrical a form as that for "other" cars in Table 2.

*In this total we disregard the two erratic compensatory errors of +8 in Case 14, of Table 2, and —8 (out of —9), of Case 12.

Table 3.—Sill Renewals of Refrigerator Cars.

(Sills taken out starred; sills left in dotted.)

	Side (16)	Interm. (12)	Center. (18)	Time allowances in hours. M.C.B.	By our rule.	Excess by our rule.	
1	**	**	**	120	122	+2	+2
2	**	**	*.	107	104	-3	
3	**	*.	**	110	110	0	
4	*.	**	**	106	106	0	-3
5	**	**	..	81	86	+5	
6	**	..	**	104	98	-6	
7	..	**	**	88	90	+2	
8	**	*.	*.	100	92	-8	
9	*.	*.	**	96	94	-2	
10	*.	**	*.	92	88	-4	-13
11	**	*.	..	72	74	+2	
12	**	..	*.	77	80	+3	
13	*.	**	..	60	70	+10	
14	*.	..	**	93	82	-11	
15	..	*.	**	78	78	0	
16	..	**	*.	71	72	+1	
17	*.	*.	*.	79	76	-3	+2
18	**	..	..	63	62	-1	
19	..	**	..	54	54	0	
20	..	..	**	70	66	-4	
21	*.	*.	..	50	58	+8	
22	..	*.	*.	65	60	-5	
23	*.	..	*.	70	64	-6	-8
24	*.	..	..	44	46	+2	
25	..	*.	..	40	42	+2	
26	..	..	*.	44	48	+4	+8
Total of 26 items.				2,034	2,022		-12

THE THREE-CLASS SYSTEM OF PASSENGER ACCOMMODATION ON ENGLISH RAILWAYS.

The improvement of passenger accommodation on English railways is a matter which comes up regularly at the annual meetings of the railway companies, and with it comes the closely-allied question of the abandonment of second-class cars and accommodation. The first step in reducing the number of classes was taken some years ago by the Midland Railway, through the liberal and progressive ideas of the late Sir James Allport, then General Manager of the road. The Great Northern Railway, the Manchester, Sheffield & Lincolnshire Railway, and some of the Scotch railways, have followed this example, but as a whole the English railways still cling to the three classes. On the better lines the third-class cars have been so much improved that they are nearly, if not quite, equal to the modern second class, and as a consequence, so many of the "best" people ride third class that there is now little remaining of the old social distinction between the travelers of the different classes. When the move was first made for the two-class system, there was a much greater social distinction, so the second or intermediate class was eliminated, and the rather awkward distinction of first and third class retained. With the social leveling already referred to, it would seem better and more practical to abolish the present third class, and run the second class at third class rates. In the semi-annual report of the London, Brighton & South Coast Ry. Co., read in July, Mr. Laing, the President, stated that in 25 years the first and second class receipts had decreased, and the third class increased. The relative changes are shown by the table which we give below:

	First-class.	Second-class.	Third-class.
1867	1,272,000	1,250,000	1,552,000
1891	1,088,000	937,000	5,250,500
Decr. —; incr. +	—184,000	—313,000	+3,698,500

Mr. Laing said that notwithstanding this progressive falling off in the first and second classes, he saw no reason to alter the opinion he had already expressed against altering the present system of classes on this line. "If we suppressed the second class it would be no boon to the third-class passengers, who are our best customers, and unless we reduced our first-class fares to a level with the present second, probably all those who now go by second class, and a good many of those who now go by first class, would transfer themselves into the cheaper class. If we are going to try experiments on our fares, I would rather try them for the benefit of the third class than of the first and second."

In this latter sentence Mr. Laing unintentionally struck a keynote, and probably did not recognize the real meaning of his phrase. Why should not

the change be made in the direction of leveling up, rather than leveling down. The third class therefore being abandoned, the first and second classes only being retained, and third class being substituted for second class fares. We do not mean specially to suggest that this should be done on the road mentioned, but merely instance this case as pointing out a general principle. In fact, the London, Brighton & South Coast Railway has a considerable difference between its second and third class cars, and, like most of the southern roads, has some very old and uncomfortable third class cars. But traveling on English railways is not too comfortable, anyway, and the companies could probably improve their financial results generally by improving the accommodation and encouraging traffic. One great objection made to the elimination of the second class is that it is so extensively used by the season-ticket holders and commuters, the special rates allowing them to ride in cars somewhat (or, on some roads, very materially), better than the third class, without incurring the expense of the aristocratic first class. But as the first and second class cars are in many trains nearly empty, it certainly seems that economy and convenience would both be attained by issuing first class tickets to commuters at the present second class rates, and also issuing third class commuters tickets. The objectors would be the semi-aristocratic and would-be exclusive people, who are now frequently able to enjoy a first class compartment to themselves, but there seems no reason why the railway companies should give these people such accommodation to the detriment of the traffic in general, and as it is the third class which pays best, it seems good policy to cater for that traffic. Every railway is from time to time agitated over the two-class system, but most of them are too conservative and near-sighted to see the advantages of this system, and prefer to wait until others take the lead, in spite of the good results obtained on the Midland Railway.

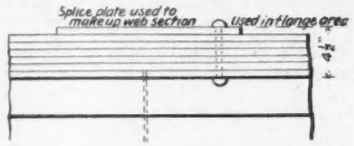
Sir Edward Watkin said about two years ago that he thought the future arrangement would consist of two classes, with perhaps a palace car service on certain trains, and it is not improbable that such an arrangement would eventually lead to the American system of one class, with special cars for the use of which an extra charge is made independent of the railway fare. If these special cars were owned by the railway, they might be more advantageous to the railway companies than if owned by separate companies. In the United States the bulk of the drawing-room, dining and sleeping car service is in the hands of the palace car companies, but the Canadian Pacific Ry. operates its own special equipment of this kind. Both systems are in operation to a limited extent in England; the Pullman Palace Car Co. having cars on several roads, while the London & Northwestern Ry. has its own drawing-room, sleeping and dining cars. We do not look for any immediate improvement in English passenger accommodation or service, but when such improvements have been gradually reached, together with improvements in the facilities for the purchase of tickets, and in the encouragement of traffic, the companies will probably wonder why they retained the old-fashioned and inconvenient methods for so long. The modern cars of English railways, and the improvement in the fittings, have from time to time been described and illustrated in our columns, and need not be described here. There would be a saving in dead load, and in switching operations in the making up of trains if the number of classes should be reduced. The Great Eastern Ry. is seeking to reduce the dead load per train due to empty first and second class cars, by building "composite" cars, with compartments for both these classes. In the improvement of passenger accommodation and the development of traffic, and in the simplification and improvement of rolling stock, there is a large field open for some enterprising railway manager to popularize his road and improve its financial returns.

The cultivation of trees is being experimented with on an extensive scale by the Canadian Government. At the Central Farm, near Ottawa, the seeds of Rocky Mountain and European conifers have been liberally sown, and 175,000 seedlings were in 1891 transplanted from the beds to be distributed later on to branch farms and private experimenters, who are to send careful reports of progress. It is said that 25 gardens along the main line of the Canadian Pacific Ry. have been supplied from the experimental farms.

LETTERS TO THE EDITOR.

WEB SPLICES.

Sir: In your issue of July 14, "C," whoever he may be, takes exception to my criticism of web splices. It



would be interesting to learn his opinion of the value of rivets in inclosed sketch, as used in the splicing of web plates, by a plate as shown. Respectfully,

Chas. H. Wright.

Edge Moor, Del., July 15, 1892.

AMERICAN LOCOMOTIVES IN NEW SOUTH WALES.

Sir: Referring to the article in your issue of July 21, headed "American Locomotives in New South Wales," I would inquire what size are the cylinders of the locomotives referred to.

Yours truly, V. P. Sanford,
Supt. Mexican Northern Ry.

Escalon, Mex., July 30, 1892.

(The ten-wheel passenger engines have cylinders 21 × 24 ins., and the consolidation freight engines have cylinders 21 × 26 ins.—Ed.)

AN EXPERIMENT ON JOURNAL FRICTION.

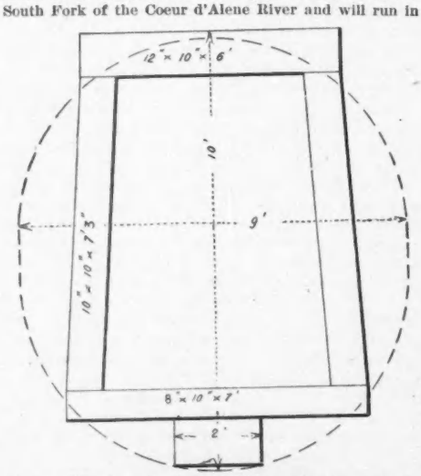
Sir: Will some one of your readers kindly send me the date and page of an article or item (or perhaps only a passing mention) describing an experiment in journal friction, where it was found that a much less force was required to produce an endwise motion of the journal while rotation was going on than was necessary with no rotation. It is barely possible that the item was in some other technical paper, but my remembrance points to an issue of the Engineering News within the last six months. Sincerely yours,

I. P. Church.

Ithaca, N. Y., Aug. 6, 1892.

THE CLEMENT MINING TUNNEL.

Sir: We have already begun work on the "Clement Tunnel," which is to be about 10,000 ft. long, and of the cross sections shown by the inclosed sketch. The dotted line shows the hard rock section, and the other, the form of timbering used in loose rock. The tunnel starts from near our concentrating plant situated on the South Fork of the Coeur d'Alene River and will run in



Sketch Showing Rock and Timber Sections of the Clement Mining Tunnel.

a direct line to our mines, which it will tap 800 ft. below the present deepest working. As any shafts sunk along the line of the tunnel would be over 1,000 ft. deep, work will be pushed from but one face. The material to be penetrated is a stratified quartzite, consisting of hard and soft bands. Proposals are now being received for an air compressor and drill plant.

Bunker, Hill & Sullivan, M. & C. Co.

Wardner, Idaho.

ASSISTING LOCOMOTIVES ON HEAVY GRADES.

Sir: In Engineering News of July 28, appears a communication from "Anxious Inquirer" asking "how the drift of the cable toward one side as the drum revolves is provided for" in a certain arrangement for "enabling a locomotive to haul trains up steep grades" by means of "taking a double turn of a stationary cable around a grooved drum keyed on the driving axle, etc."

The writer knows nothing of the actual device there alluded to, but this sidewise drift of the cable is of necessity provided for in all power plants of cable railways, and the provision could be similarly made in the case mentioned. The provision usually made in a cable power house is simply to turn the cable around two drums revolving side by side. It may be given as many turns as necessary around both drums so long as it takes no complete turn around either.

Benj. F. LaRue.

Jackson, Mich., Aug. 1, 1892.

POWER AND FORCE.

Sir: In the article on the "Disaster on the Licking River Bridge" in the last Engineering News occurred the remarkable statement that an engine of 25 HP., on being connected with a double fall tackle, exerted 100 HP., in spite of which it failed to move the pile. If such an increase of horse power can be obtained by the simple means described, it would prove of incalculable value to the progress of the human race, and the fact ought to be made extensively known. Yours truly,

Henry Szlapka.

Trenton, N. J., Aug. 4, 1892.

(Notwithstanding the error to which our correspondent refers, and which is of course obvious enough to an engineer, we think he will agree with us that the coroner's report (in which the above error occurred, and which we printed verbatim), was far above the average of coroner's reports, and showed a really intelligent understanding of the problems before him. Plenty of men confuse the terms power and force in speech, who have a correct understanding of the distinction between them. What seems to us to be really a more serious error than the one pointed out by our correspondent, is that no allowance was made by the writer of the report for the friction of the blocks and tackle. Probably the actual hoisting force of a 25-HP. engine aided by a four-fall tackle would be not more than three times what it would exert on a straight pull. In this case the coroner's theory was ahead of his practice. Ed.).

FINDING GATE VALVES.

Sir: In the design and construction of piping systems most water-works engineers adhere rigidly to a particular system in the location of the gate valves in cities. Some have posts placed on the side of the street opposite the valves. Others place them on the curb lines or on the property lines. The last method has advantages over the others, although it has the disadvantage of requiring the pipe to be cut in every case where the end of the pipe does not come just at the point selected for the valve. Then again, the property lines are not always distinctly defined, and workmen very often fail to obey orders in this respect. The real trouble is experienced when it is attempted to find the valve in an emergency, when it sometimes requires an hour or more of patient, though hopeless, digging and tearing up of the street.

A very simple and probably practical way to overcome this difficulty would be to place upon (outside of) each valve box a permanent magnet. The water superintendent assistant can then carry with him a small dip needle made of soft wrought iron. This will, of course, be non-magnetic and hence unaffected. By passing the needle over the ground on the line of the trench and in the vicinity of the valve, he can soon detect by the depression of the needle the exact location of the valve, and a foot or two of earth or stone need not interfere with the action of the instrument. In this case it will not be important to locate the valves to a nicety, merely getting them as near the property lines as possible without cutting pipe. I have not tried this device, and hence will be pleased if some of your readers who are electricians, will give their opinion as to its practicability.

J. W. Ledoux.

Philadelphia, Aug. 1, 1892.

GRANULATION OF IRON ORE.

Sir: My attention has been called to an abstract, in your issue of July 14, of my paper on "The Granulation of Iron Ore by Means of Crushers and Rolls," read before the Lake Champlain meeting of the American Institute of Mining Engineers; and also to a letter in your issue of July 28, addressed to you by Mr. E. C. Huxley, President of the Sturtevant Mill Co., of Boston, in which he protests against figures given by me as to power consumed by a 20-in. Sturtevant mill, reducing 20 tons of magnetic ore per hour to 10 mesh, and names as the power required 56.2 HP., instead of 110 HP., as stated in my paper.

Without questioning the probable correctness of Mr. Huxley's new record, which, according to his own public statement, was an agreeable surprise to himself, I wish to say that at the time when my paper above referred to was placed in the hands of the Secretary of the Institute, Mr. Huxley's "record mill" at Clover Hill was not yet running. The only Sturtevant mill at that

time in operation on iron ore was that at Messrs. Witherbees, Sherman & Co.'s works, at Port Henry, N. Y.

Mr. Huxley has quoted to me personally, as well as to other persons, the figures of 110 HP. as the power consumed for this particular mill, and we learned from discussion at the Lake Champlain meeting of the Institute that considerable greater power had at times been indicated.

It is but just, however, to state that the Sturtevant mill at this place has, at times, worked under the disadvantage of being supplied with more or less damp ore. On the other hand, the Port Henry ore is of a clearly defined crystalline nature, and easily crushed—a point in favor of the mill; but I would recommend mine owners intending to use the Sturtevant mill, or any other mill, for that matter, to follow the judicious example set by Mr. Huxley at Clover Hill, by providing an engine of at least twice the estimated power of the various machines, to drive their plant. I am greatly impressed with the magnificent work of the Sturtevant mill on phosphate rock, fire clay and other similar substances, and also, according to statements made by Mr. W. H. Hoffman, on calcined ore, and I have frequently had occasion to recommend its use for reducing similar materials. Yours truly,

New York, Aug. 4, 1892. Alex. Sahlin.

HEIGHT AND DISCHARGE OF FIRE STREAMS.

Sir: In your issue of July 14 you publish a paper by J. T. Fanning (p. 42) on fire service, etc., a paper valuable in itself, but containing numerous errors (presumably compositors') which detract very seriously from its merits. But what has struck me very forcibly is the wide divergence from what I had hitherto supposed to be approximately correct. To illustrate this I inclose herewith a table of comparisons on 70 and 80 ft. streams.

In my practice I have hitherto used for convenience the "tables" for heights and nozzle pressure and Box for discharges, as I believed if Box erred at all it was on the side of safety.

The matter is one, from its importance, that merits attention and a definite solution. Fanning's paper places me very much at sea, and I would like very much to know what is the matter.

Fanning may be very safe, perhaps too much so, and it is very important to know what can be legitimately relied upon in practice, as deduced from the most exhaustive experiments so that an engineer can plan intelligently. Yours truly, Garwood Ferris.

Jersey City, July 16, 1892.

(On receipt of this letter we wrote to Mr. Ferris asking for the errors he had discovered, and also to Mr. Fanning, asking his opinion on the questions raised in the above letter. We append the replies received.—Ed.).

Sir: I have had neither time nor inclination to go over the article in detail, but happened to notice that 700 gallons a minute was extended as 1,208,750 gallons per 24 hours; that in Table 1, nozzle diameters were headed feet instead of inches and that the deductions for available heads required at hydrant, through 100, 200 and 300 ft. of 2½-in. rubber hose, 1⅛-in. stream, were very evident errors such as J. T. Fanning could not possibly have made (see second column, p. 43, paragraph commencing "Our standard single 1⅛-in. stream").

Typographical errors that are evident on a very cursory examination don't amount to much, however, but what struck me was the wide divergence of conclusions, as to pressure required and volume of discharge in fire streams, of parties I had considered as authorities, and I would like very much to know which is the nearer correct. Yours truly, Garwood Ferris.

Jersey City, N. J., July 20, 1892.

Sir: I have your letter relating to the inquiry of Mr. Garwood Ferris about the discrepancies in published tables of the discharges from hose nozzles for given pressures. I quote here, for reference, Mr. Ferris' table, and add to it for comparison, a fifth column taken off from my diagram of discharges for given pressures at the play pipe:

Vertical height of Stream. Feet.	Pressure at the Nozzle. Pounds.	Size of Nozzle. Inches.	Discharge per Minute.	Discharge by Fanning's Diagram. Gallons.	Discharge by Diagram. Gallons.
70	46.5	1	Fanning,	203	203
71	35.	1	Tables,	145	174
70	34.65	1	Box,	164.4	173.5
70	43.	1¼	Fanning,	306	306
73	35	1¼	Tables,	228	277
72	34.65	1¼	Box,	258	276
80	59.	1	Fanning,	230	230
83	43.	1	Tables,	161	193
84	43.31	1	Box,	183.6	194
80	53.5	1¼	Fanning,	343	343
82	40.	1¼	Tables,	242	295
80	38.98	1¼	Box,	272.4	296

So far as these tables are based on experiments, the differences may be accounted for largely in the differences of statements of heights of similar streams. If the altitude of the upper drops at the apex of the stream is taken as its height, then its tabled discharge for that height will seem small. On the other hand, if the altitude of the highest portion of the solid stream is taken, its tabled discharge may seem large. My diagram is based upon the experiments, of wide range, by Mr. John H. Freeman, C. E., as published in the Trans. Am. Soc. C. E., Nov., 1889.

I consider both his method of measuring the height of a "good effective fire stream" and his measurements of discharge to be reliable. In comparing my diagram with the discharges given by Box, for the above quoted pressures, I find his discharges to be about 6% less, indicating that the heights of jet taken in his case were probably nearly extreme height. It is to be noted that Box's discussion relates to fountain jets; and Box says: "The best experiments we have are those of Weisbach, with jets of ⅝ and ⅞-in. diameter." Box mentions some larger jets with which he compared computations by his own formula. Mr. Freeman's experiments cover the usual range of fire service.

Yours respectfully, J. T. Fanning.

Minneapolis, Aug. 2, 1892.

AN EIGHT-HOUR LAW FOR GOVERNMENT CONTRACTORS.

The following is the text of the eight-hour law passed at the session of Congress just closed. Every contractor bidding on river and harbor or other Government work, as well as every engineer in Government employ, will do well to scan it closely. We have commented on it in our editorial columns:

Sec. 1. The service and employment of all laborers and mechanics who are now or may hereafter be employed by the Government of the United States, by the District of Columbia, or by any contractor or sub-contractor upon any of the public works of the United States or of the said District of Columbia, is hereby limited and restricted to eight hours in any one calendar day, and it shall be unlawful for any officer of the United States Government, or of the District of Columbia, or any such contractor or sub-contractor whose duty it shall be to employ, direct or control the services of such laborers or mechanics to require or permit any such laborer or mechanic to work more than eight hours in any calendar day, except in case of extraordinary emergency.

Sec. 2. That any officer or agent of the Government of the United States or of the District of Columbia, or any contractor or sub-contractor whose duty it shall be to employ, direct or control any laborer or mechanic employed upon any of the public works of the United States or of the District of Columbia, who shall intentionally violate any provision of this act shall be deemed guilty of a misdemeanor, and for each and every such offence shall upon conviction be punished by a fine not to exceed $1,000 or by imprisonment for not more than six months or by both such fine and imprisonment, in the discretion of the Court.

Sec. 3. The provisions of this act shall not be so construed as to in any manner apply to or affect contractors or sub-contractors, or to limit the hours of daily service of laborers or mechanics engaged upon the public works of the United States or of the District of Columbia for which contracts have been entered into prior to the passage of this act.

WATER-SUPPLY OF FLORENCE.

The city of Florence, Italy, derives her water supply at present from two galleries, situated 12 and 14 ft., respectively, under the bed of the Arno River. We abstract the following details from the "Journal fuer Gasbeleuchtung und Wasserversorgung":

A former source of part of the water supply of the city was located at Monte Reggi, where the water was taken from sand and gravel deposits of the river Mugnone, a tributary of the Arno. The water was conducted by gravity to the reservoir 197 ft. above the quay of Florence. This conduit was subsequently closed up, as it was asserted that the water, which in the rainy season showed a muddy color, was the direct cause of the typhoid fever epidemic then raging. One of the two galleries mentioned above is carried across the bed of the river to the opposite shore, and is fed by a well near the Campo di Marte. The other, 230 ft. long, runs parallel to the bed of the river. Both galleries are of masonry, and are constructed in the sand and gravel deposits of the river Arno. The water enters from below, and also through side openings in the walls, placed five ft. apart and two ft. above the bottom of the structures. Several turbines driven by the fall of the Arno, raise the water into three reservoirs, whence it is elevated from 131 to 197 ft. above the quay, having a total capacity of 9,510,480 gallons, distributed by gravity. The quantity of water delivered varies between 1,200,170 and 2,400,340 gallons. There are at present 3,200 of the 12,000 houses and 180 public wells in the city supplied with water. It is contemplated to extend one gallery from 1,000 to 1,300 ft. up the river in order to meet the increasing demands of the city. The city authorities will see that the river is kept perfectly free from pollution. Lately the city council of Florence purchased the mountain springs near Lucca, 69.6 miles from the city, which are capable of delivering 15,850,800 gallons a day under high pressure. It is estimated that the construction of this latter plant will take about three years.

THE INVENTION OF THE PELTON WATER WHEEL.

A correspondent of "Power" tells the following curious story in regard to the invention of this now famous wheel, from which it would appear as if the wheel ought to be called the Atkins rather than the Pelton wheel. The wheel is of such recent introduction that we find no mention of it in Knight's Mechanical Dictionary or the Century Dictionary, though Mr. Atkins' original patent expires in about 30 days:

The principle involved in the Pelton wheel has a curious history. It was embodied in a turbine invented by Jearum Atkins. The wheel was built by him and an application for a patent filed, the money being supplied by some friend. In due course, as was then and is now the custom in the Patent Office, the application was rejected. The friend thought that was the end of it, and insisted on withdrawing the $20 of the fee which at that time was returned if the rejection was accepted. Shortly after, Mr. Atkins was thrown from his wagon, and his spine so injured that for upward of 24 years he was bedridden. While in that condition, however, he made many inventions and acquired a competency. He finally recovered the use of his lower limbs, and was, and still is—for he is living yet—one of the ablest mathematicians in America, and among other things he perfected the details of his wheel and applied for a patent, which was granted Aug. 10, 1875, No. 166,676. In his application he embodied a full mathematical exposition of the action of the water on the wheel, showing that the entire momentum of the water is imparted to the wheel if it enters, as in the Pelton, at one side of a semicircular bucket and escapes at the other, the direction of its motion being exactly reversed in transit. Under these conditions the wheel will move with half the initial velocity of the water, and the spent water will fall away without residual velocity. The mathematics of the specification was too deep for the Patent office examiner, and he required its cancellation upon the ground that it was not necessary. Afterwards he admitted to me that he did not consider the demonstration necessary, and did not know whether it was true or not. Any one curious to know will find it embalmed in the original specification of that application. The Pelton wheel embodies the same principle, and if more perfectly formed would realize the full theoretical value of the jet.

THE MEMPHIS BRIDGE.

We have received from Mr. Geo. S. Morison, Chief Engineer, a view of the completed structure of the Memphis bridge, which is very similar to that given in our issue of May 12, except that the main span has been closed. The view shows the bridge at the time of the test made on May 12, with 18 locomotives upon it, 15 on one span. The bridge was very fully described and illustrated in our issues of May 12 and June 16, and we give below a tabulation of the lengths and weights:

East of anchorage.....	101 ft.	0 ins.	66,700 lbs.	
Anchorage span.....	225	10	1,603,000	"
Channel "	790	5	4,699,300	"
Central "	621	6¾	5,274,300	"
West "	621	6¾	3,518,800	"
Deck "	338	9	1,073,000	"
West viaduct....	2,290	7½	3,306,600	"
Total	4,988	9	19,541,700	"

The heights are as follows:

Highest point to bottom of lowest chord...	80 ft.	6 ins.
Lower chord to high water.....	75	4 "
High water to low water.....	34	7 "
Deepest foundation below low water.....	96	3 "
Total.....	286	8 "

Construction was commenced Nov. 7, 1888, and the bridge was opened for traffic May 12, 1892, carrying the railways meeting at Memphis, Tenn., across the Mississippi River. The bridge was designed and built by Mr. George S. Morison, Chief Engineer, and Mr. Alfred Noble was Resident Engineer.

DREDGING ON THE PACIFIC COAST.

(Continued from p. 116.)

After having thus described the various types of scoop dredges somewhat more fully than in our abstract, Mr. Miller proceeds as follows in regard to the more novel and (as respects dredging) more important subject of hydraulic dredging. The matter on this subject we quote with very little abbreviation, as it is nearly all directly to the point, but we again caution all concerned that the statements herein in regard to novelty, patent rights, etc., are ex parte, and not to be accepted without question:

Hydraulic or suction dredges take their name from the fact that they utilize the power of suction. In the dredges heretofore considered no such principle was used, the spoil being conveyed mechanically from the excavator to the dump. In hydraulic dredges the spoil, after being severed from the bottom, is delivered into a suction pipe, through which it is drawn by the power of suction and delivered at the desired place of deposit. The essential elements are a hollow rotary excavator, provided with side-cutting excavating devices, and a side feed or swing while working, a suction pipe connecting therewith, a centrifugal pump, and a discharge pipe of any desired length. In operation the excavator severs the spoil from the bottom and delivers it through itself to the suction pipe up which it is drawn by the centrifugal pump, which also propels it through the discharge pipe. This discharge pipe is usually supported by pontoons on the water, and is designated as a floating discharge pipe. By this style of dredge material may be taken from the bottom of a bay or river and deposited at any desired point thousands of yards distant. Evidently this is a vast improvement on a simple scoop, whose capacity and range of deposit are limited.

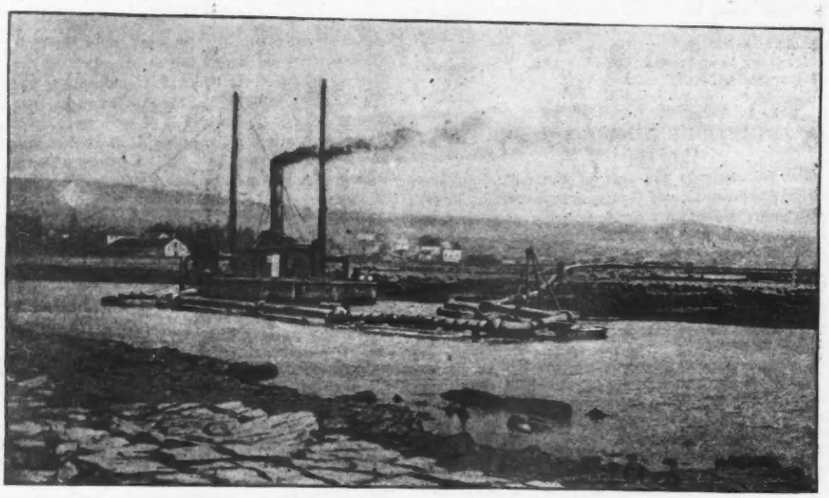


FIG. 1. VON SCHMIDT DREDGE, EAST OAKLAND

Attempts have been made from time to time to build levees with hydraulic or suction dredges. These efforts have been but moderately successful and this in sand only. The best of these was what was known as the Von Schmidt dredge, not the improved machine used by him since 1883, but the dredge covered by his first patent. This also was built for and used by Messrs. Williams & Bixler, who have shown great energy and enterprise in swamp-land reclamation, and who are entitled to great credit therefor. This machine was originally provided with a suspended discharge pipe about 80 ft. in length and a propeller-shaped agitator in the mouth of the suction pipe. This agitator proved to be an impediment, which it was necessary to remove, as it did not answer the purpose for which it was intended, and the dredge did much better without it. In the loose sand brought down by the current of the Sacramento nearly as fast as it could be pumped up, this dredge, with no device for excavating, and used simply as a sand pump, was employed for several years in building sand levees on Grand Island.

Its owners, Messrs. Williams & Bixler, made numerous unsuccessful attempts with and without the agitator in various kinds of dredging, after which, in 1883, they changed it into what is now known as the Atlas dredge, similar to the one employed by the San Francisco Bridge Co., except that, though working on the same principle, its side-cutting edges were of a somewhat different construction. The next form of hydraulic dredge we shall consider is that known as the Von Schmidt dredge, Fig. 1.

In the fall of 1882, Col. A. W. Von Schmidt was awarded a large contract for dredging in Oakland harbor. Substituting an excavator with inward delivery for his old agitator, and a floating discharge pipe for the suspended pipe used by him on his first machine, built by Williams & Bixler, he got to work in March, 1883, and, after various delays, alterations and improvements, incidental to almost all new inventions, made what was then regarded as a great success, he having in the month of April, 1884, put 63,081 cu. yds. on shore through several thousand feet of pipe. This, though in very soft material, fairly astonished the world. In the hard compact sand and clay below the Oakland bridge, the performance sometimes ran as low as 90 cu. yds. per hour. This machine is now at work at Baden, cutting, under the most favorable circumstances, and in the best possible material, a navigable channel into, and an inner basin or artificial harbor within, the marsh. Besides the one used on this coast several of these machines have been built and used in the East, notably in the improvement of the Potomac flats, at Washington, D. C. One or two have also been used in Australia. To Col. Von Schmidt must be awarded the credit of having, in 1883 and 1884, executed the first large work ever anywhere attempted with a suction dredge having a rotary excavator and floating discharge pipe. This machine as now constructed is claimed to be an infringement of the Bowers patents, and suit for infringement is pending.

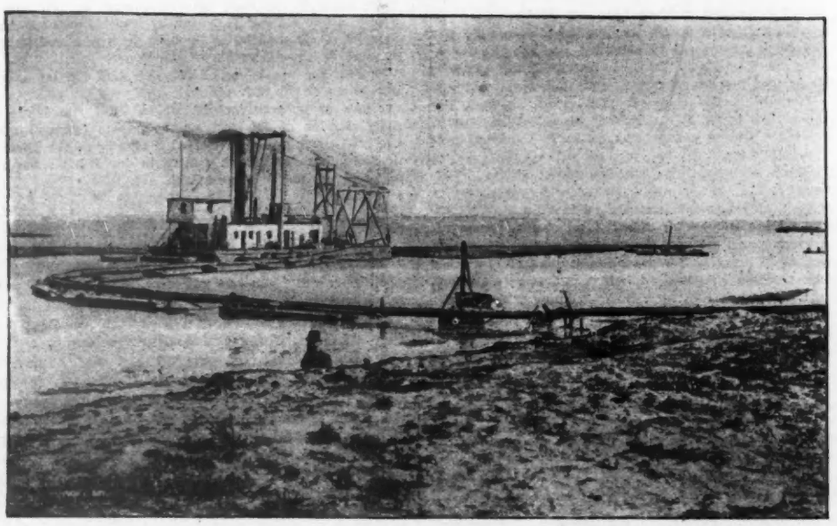


FIG. 2, ATLAS DREDGE "ALAMEDA."

Fig. 2 shows what is commonly styled the Atlas dredge. It was taken from the machine owned by the San Francisco Bridge Co., and now at work in the Oakland harbor. It was built by the Golden State and Miners' Iron Works for the purpose of making an artificial harbor, some five or six miles south of Santa Monica. The material there to be excavated was a tough, dark clay, very tenacious and difficult to excavate. The dredge proved to be incapable of performing the work required, and it lay idle for a year or more. In 1889 it was purchased by the present owner, repaired and put to work in the soft mud of the Oakland basin, where it has done a large amount of work, and it is now engaged in digging an inter-tidal canal for the U. S. Government, connecting the waters of San Antonio Creek with those of San Leandro Bay. This is the only dredge owned by the San Francisco Bridge Co., though this company is now building another in Boston, regardless of the fact that it is entirely covered by the Bowers and partly covered by the Angell and other patents. The Atlas is an excellent machine, differing from the Bowers dredge only in a few trifling details of construction, and suit is pending against it and the San Francisco Bridge Co. for infringement of the Bowers patents.

The Bowers dredge takes its name from the inventor, Mr. A. B. Bowers, of San Francisco. As early as the year 1863 this inventor turned his attention to the subject. From that time until 1885, when his first patent was issued, he was engaged in experimenting, testing, building and patenting his dredge. Since that time several of them have been put into successful operation. Previously, however, in 1878, Mr. Bowers had built a small experimental machine, known as the Bowers dredge, for the purpose of testing his invention. It had a rotary excavator with inward delivery through itself to a suction pipe, a floating discharge pipe, a side-feed apparatus, and a pivot carried by the hull on which it swung from side to side while working. The dredge was a very crude affair, mechanically considered, as it was rigged up from second-hand materials and odds and ends merely for the purpose of testing the principle of the invention. It was never intended for doing actual work. In fact, it was not supposed to be large enough nor strong enough for anything further than tests, though the testimony in the pending suits shows its capacity to have been much greater than had been anticipated. Rival interests have always claimed it to be a failure, but eminent engineers who witnessed its operation and tested its capacity have testified that it was a marvelous success. If these statements and testimony are true they establish the fact that the machine was the first successful hydraulic dredge suitable for ordinary dredging operations ever put in operation. The essential features of the Bowers dredge are a hollow rotary excavator, having a series of revolving side-cutting devices and an inward delivery through itself to a suction pipe, a centrifugal pump and a floating discharge pipe, together with an arrangement of spuds for feeding the machine forward and devices for swinging horizontally in a circular arc during the act of excavating.

For about three years past the Bowers dredge "Anaconda" (Fig. 3) has been at work in the state of Washington, where, though but of the second class in size and power, she has established a wide reputation and greatly surpassed all previous records. She has filled in about 35 acres of mud flats for the Northern Pacific R. R. at Tacoma, a terminal of less size for the same road at Olympia, and made a good beginning in the filling of some 300 or more acres at South Bend on Shoal Water Bay. The material handled has been mostly sand interspersed, sometimes, though rarely,

with cobblestones, and much of it exceedingly hard and compact. Her best record is 165,000 cu. yds. of sand, measured in the fill, in 20 days, an average of 8,250 yds. per day, or at the rate of 201,500 yds. in a month of 26 working days. This is said to be more than three times as much sand as was ever handled by any other dredge in the same time, and delivered through pipes on land. It has never had an opportunity to test its power in soft material like that in the Oakland basin and the most of that handled by the Von Schmidt and Atlas dredges, but, as these latter handle from three to four times as much mud as they do of compact sand

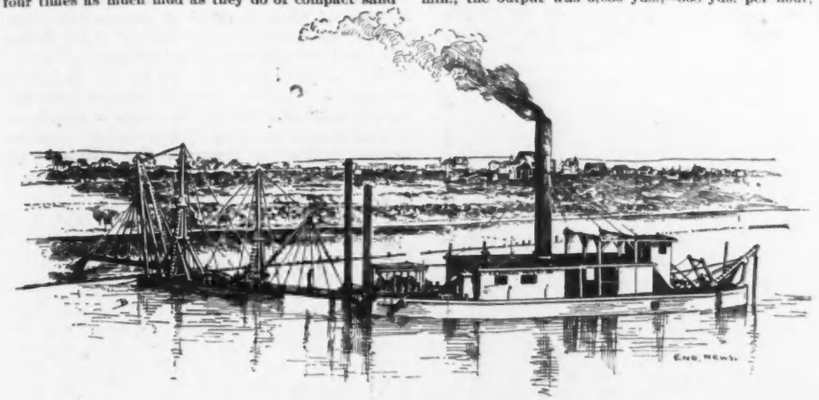


FIG. 3. BOWERS DREDGE "ANACONDA," GLORIETTA BAY.

in the same number of hours, it is evident that the second-class Bowers dredge "Anaconda" would handle at least 10,000 cu. yds. per day in such material as that at Oakland or Baden. The discharge from the "Anaconda" is shown in Fig. 4.

The "Python," or No. 4, a Bowers dredge of the first class, at Portland, Ore., is shown in Fig. 5. It has been raising, from a depth of 25 to 40 ft., coarse gravel from 1 to 2 ins. in diameter, and as large cobblestones as could pass through the cutter and pump, or about 5 ins. in diameter, delivering it at an elevation of about 30 ft. above water, and through an 18-in. discharge pipe, about 1,000 ft. in length. This work was done solely for the purpose of bringing the East Portland river lots up to the city grade. It is perhaps the only dredge in the world capable of doing this work in this manner, as the Von Schmidt dredge was unable to carry out her contract to deliver sand at a less elevation in Sacramento. Bowers dredges have been built in Boston, Chicago, Kansas City, San Diego, San Francisco and Portland, Ore.

The "Anaconda" was first used at Glorietta Bay, Coronado Beach, near San Diego, where she dug a channel from the boat-house of the Coronado Hotel to deep water. Mr. Miller gives the following interesting statement, for the purpose of showing the value and efficiency of the Bowers dredge in respect to the character of the material there handled, and the success with which the dredge handled it:

The testimony shows that the material handled at Glorietta Bay by the "Anaconda" was about 90% sand and shell with sufficient clay to fill the interstices. For a few inches from the surface it was loose and soft, but got harder and more compact below, and at the depth of 3 ft. became so hard that the iron-pointed vertical anchor or spud, weighing 2½ tons and dropping 12 ft., would penetrate but 3 ins., or but 8 ins. on being dropped three times. The feeding device enabled the machine to be fed forward for each new series of cuts, in considerably less than one minute, even when the pivotal anchor has to be raised and dropped three times on account of the hardness of the bottom. This forward feed has sometimes been made in 25 and often in 30 seconds; and as a full swing of the dredge, varying from 120 to 180 or 200 ft., according to the length of the hull, can, in ordinary material, be made in from 4 to 8 minutes, in shallow cuts where the machine is fed forward on each swing, this device effects a saving of fully one-half the time, and doubles the output of the machine, as it holds the dredge always in working position so that the cutter misses no ground, and goes twice over no ground.

The average performance in repeated tests was as follows:

Clear water raised per minute, 10 ft. above surface and discharged through 258 ft. of 18-in. pipe, 19,800 to 20,000 gallons. Sand and water discharged in the same way, 10,000 to 11,000 gallons.

In the lowest and hardest cut, the dredge raised and delivered, as above, 4.19 cu. yds. per minute. In 36 hours the output was 12,444 yds.=346.66 yds. per hour, or 5.57 yds. per minute. In similar material, in Oakland Creek, a large Osgood scoop (capable of handling 2,500 yds. of mud in 10 hours) delivered in scows an average of not over 200 yds. in 10 hours, as against 3,466.6 yds. put on shore by the Bowers dredge "Anaconda" in ten hours.

The Atlas dredge, at the same place, delivered on shore, through 600 ft. of pipe, 500 yds. in 10 hours, a little over one-seventh the output of the "Anaconda."

At Glorietta Bay, working to a depth of 5 ft. below the surface of the bottom, the delivery of the "Anaconda" was 7.66 yds. per minute. On one run of 5 h. 20 min., the output was 3,030 yds.,=568 yds. per hour, or 9.46 yds. per minute. Cutting to depth of 3 ft., feeding forward each swing, the average output was 12.79 yds. per minute.

In the softest material encountered (a small quantity that had formerly been dredged with a sand pump and dumped into the water), consisting mainly of loose sand, the dredge made a clean cut of 20 sq. ft. face and 145 ft. swing in 4 minutes, the cutter (4 ft. in diameter and 4 ft. long) being fed forward its entire length and lowered one foot below the surface of the bottom. This equals 26.85 cu. yds. per minute, the earth measuring 53.22 per cent. of the entire delivery. It is regretted that there was not enough of this material to get a fair average for even one day's performance.

These are alleged to be actual results "from careful measurements obtained, with a green crew learning to handle the machine, and during the first 150 hours' actual work."

The material at Coronado Beach (Glorietta Bay) was represented to be soft, and the dredge was supplied with a cutter designed for soft mud and loose sand. It is alleged that the above "could easily have been doubled with the cutter for hard material. Even in soft material a larger cutter should be used, for when working to its utmost capacity in the loose sand and discharging nearly 27 yds. per minute it did not begin to furnish what the pump could handle."

Comparisons are then invited between the first 26 days' work of the Von Schmidt dredge in the soft mud flats of Oakland from March 5 to April 1, 1883 (13,258 yds.), with the first 4½ days' performance of Bowers dredge in hard bottom, at Glorietta Bay, 15,474 yds.; and between the performance of Von Schmidt dredge No. 1, Potomac Flats, from Dec. 24, 1884, to April 1, 1885, 24,534 yds.; April, 38,688 yds.; and following June, 68,315 yds.—with Bowers dredge at Tacoma, March, 1891, 165,000 yds. in 20 days. The following general comparison is then given, which we again caution the reader is ex parte, but which we believe at least states facts, though it may not state all the facts of record, and so may do more than justice to the Bowers machines:

In order that the reader may see at a glance the comparative merits of the several styles of dredges heretofore mentioned, we put the matter in the shape of a brief recapitulation:

Osgood (scoop), hard bottom, Oakland Creek, 10 hours, 200 yds.

Atlas (hydraulic), hard bottom, Oakland Creek, 10 hours, 500 yds.

Bowers (hydraulic), hard bottom, Glorietta Bay, 5½ hours, 3,030 yds.

Von Schmidt (hydraulic), soft mud, Oakland, first 26 days, 13,258 yds.

Bowers (hydraulic), hard bottom, Glorietta Bay, first 4½ days, 15,474 yds.

Bowers (hydraulic), loose sand, Glorietta Bay, per minute, 26.85 yds.

Bowers (hydraulic), compact sand, Tacoma, 165,000 yds. in 20 days, or 8,200 yds. per day.

Both the Atlas and Von Schmidt machines are said to have handled larger quantities of soft material since the above testimony was procured; but we have no reliable data as to the exact quantities.

Mr. Miller ends his monograph by a summary of the merits of Mr. Bowers' claim, which does not particularly interest the technical reader. The patents already issued to him are ten in number, and one other has been allowed by the Patent Office, with 71 claims, though not yet issued. The ten patents already issued are the following:

May 26, 1885, No. 318,859, having 103 claims; May 26 1885, No. 318,860, 8 claims; Dec. 28, 1886, No. 355,251, having 22 claims; May 31, 1887, No. 364,158, having 37 claims; June 7, 1887, No. 364,571, having 18 claims; Nov. 8, 1887, No. 372,956, having 18 claims; Aug. 21, 1888, No. 388,252, having 28 claims; Aug. 21, 1888 No. 388,253, having 21 claims; Aug. 21, 1888, No. 388,-257, having 15 claims; Sept., 17, 1889, No. 411,183, having 22 claims; making a total of 363 claims, both general and special.

Upon these patents, or some of them, Mr. Bowers has brought suits for infringement in the U. S. Circuit Court against numerous parties, which suits are now pending. Some idea of the magnitude of the litigation may be gathered from the fact that over 8,000 folios of typewritten testimony have so far been taken, and a great deal more remains to be introduced. Whether Mr. Bowers wins these suits or not, he will ever deserve an honorable place among the improvers of the art of dredging.

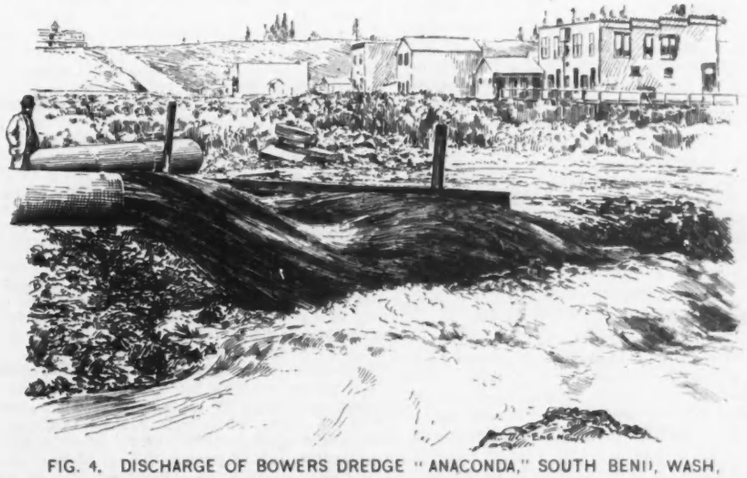


FIG. 4. DISCHARGE OF BOWERS DREDGE "ANACONDA," SOUTH BEND, WASH.

A LONG DISTANCE ELECTRIC POWER TRANSMISSION PLANT.

Some additional particulars concerning the long distance power transmission plant to be built in Southern California for the San Antonio Electric Light & Power Co., by the Westinghouse Electric Co., are furnished us by the Pelton Water Wheel Co. We briefly described the projected plant in our issue of March 26, 1892.

The water is brought to the power station through 1,900 ft. of 30-in. and 600 ft. of 24-in. double riveted sheet iron pipe, which involves a loss of head by friction of 12 ft., leaving 390 ft. effective head or running pressure. The laying of the pipe line necessitated a rock tunnel 1,300 ft. in length as well as several heavy open cuts. The power station is provided with four double-nozzle Pelton wheels 34 ins. in diameter coupled direct to the armature shafts of as many Westinghouse alternating current generators of 200 HP. each. The wheels will run under above conditions 600 revolutions per minute, giving the same speed to the generators. Two exciters are

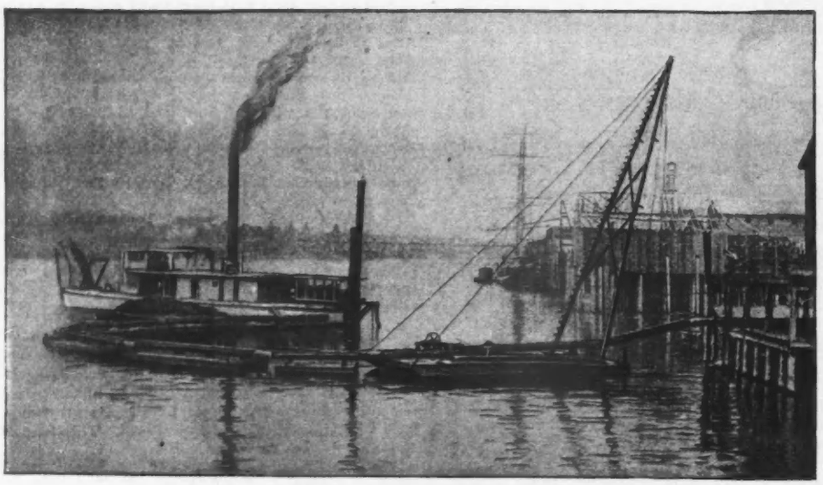


FIG. 5. BOWERS DREDGE, "PYTHON," PORTLAND, ORE.

provided which are also run by Pelton wheels coupled to the shafts in the same manner, of 20 HP. each.

The current thus generated will be carried on two No. 7 bare copper wires 7 miles down the canyon to a point where they diverge, one running to Pomona, 15 miles, and the other to San Bernardino, 28 miles, covering by the return circuit in the latter case a distance of 56 miles. By means of transformers the potentials will be raised at the generating station to 10,000 volts and the current carried at this pressure to sub-stations located just outside the cities named, where by means of step-down transformers it will be reduced to about 1,000 volts and then distributed for light and power purposes.

The motors used will be of the Westinghouse synchronous type. The sub-stations will be provided with regulators by which means the attendant can regulate the voltage of the distributing circuit independently of the generating plant.

LIFTING AND HAULING APPLIANCES AT THE PORTSMOUTH DOCKYARD, ENGLAND.

At the meeting of the Institution of Mechanical Engineers, held at Portsmouth in July, there were three or four papers presented relating to dockyard work. One of the most interesting of these was a description of the lifting and hauling appliances used at the Portsmouth dockyard, by Mr. John F. Corner, R. N., Chief Engineer of the dockyard. In the discussion it was asserted that in one respect this particular dockyard is not up to modern practice, as sheer legs are still used for hoisting, while in London and Liverpool fixed sheer legs have been almost entirely superseded by floating cranes, with the result of effecting a great gaining in time. The following is an abstract of the paper:

In addition to the ordinary hand-power appliances, there in use in Portsmouth dockyard three separate systems of mechanical power for working cranes, capstans, etc.; namely, steam, hydraulic and pneumatic power. The first of these, besides being directly employed, is also used to produce the pressures required for the two other systems. There are 96 boilers in almost constant use, with an aggregate of 784 sq. ft. of grate surface, developing an average of 3,150 I. HP. during working hours, and burning about 10,000 tons of coal per annum. Most of these are fitted with feed-water heaters, supplying feed-water at a temperature of about 130° F. Most of the boilers are worked at pressures of from 60 to 80 lbs. per sq. in. For the supply of hydraulic power there are three separate pumping stations for general service, and the pipes are so connected that any of the pumps can be used for the system. Water being cheap no return pipes are used. The first pumping station, near the main entrance to the yard, includes two separate sets of engines, each with a pair of pumps; the larger set developing about 128 I. HP. the smaller set about 40 I. HP. The latter is chiefly employed as a stand-by. The hydraulic machines in connection with this station comprise eight cranes, with lifting powers ranging from 3,360 to 22,400 lbs., nine capstans, nine elevators, and the chain cable testing machines. The second pumping station is at the iron foundry, the pumps being worked from the shop shafting, and this primarily for the use of the foundry. The third pumping station is at the head of one of the docks, with an engine developing about 112 I. HP. The total length of pressure pipes, varying from 1½ to 4 ins. diameter, is about 10,000 ft., or nearly two miles. All the pipes are placed underground, and no serious trouble from frost is experienced in cold weather, it being only necessary to light small gas jets in the various engine boxes at the cranes and capstans.

In addition to the main system there are certain self-contained local hydraulic systems. One of these is in the smithy, for working two 40-ton cranes with travelers; another in the boiler shop, for working the riveting machines, hydraulic presses, etc., and a third for stretching boiler tubes. Tubes removed from boilers for cleaning are stretched, in order to obtain new good ends, and put back again, instead of being replaced by new tubes, as was formerly the case. A new additional hydraulic system, with boilers and engines, is being fitted up by Tannett, Walker & Co., for coaling the fleet either direct from the shore or by means of lighters. This plant comprises ten 1½-ton traveling cranes, three 10-ton coal tips, and the requisite capstans, weigh bridges, etc. In this case return pipes are used.

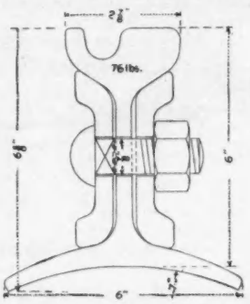
In the most modern part of the dockyard compressed air is chiefly employed for operating the lifting and hauling appliances. The air is compressed to a pressure of 60 lbs. per sq. in. in eight wrought iron receivers with a total capacity of 18,000 cu. ft., by one or other of two separate sets of pumps. One set of two pairs of compressing pumps is driven through gearing by a pair of simple engines of 90 I. HP.; the other set is driven by a pair of compound beam engines of 200 I. HP. The larger set of air-compressing pumps will fill the eight reservoirs to 60 lbs. pressure in one hour. The air pipes have a total length of 14,000 ft., or about 2⅔ miles, and vary from 3 to 12 ins. diameter. These pipes are connected to forty 7-ton capstans, five 20-ton cranes, and to the machinery for working seven caissons and numerous penstocks, besides driving a small engine. The machinery for the sliding caissons is operated by air engines, and the air pressure is also used occasionally for driving small engines for temporary installations, and certain work on board ships in the docks.

The direct use of steam for lifting appliances is chiefly confined to heavy cranes and sheer legs, to portable machines, and a few other cases. There are various steam cranes in different parts of the yard, besides the traveling cranes in the iron foundry.

As to the comparative advantages of the three systems of power, the results of experience are greatly in favor of the pneumatic system. Experiments have shown that the relative economical values of the air and hydraulic systems when applied to capstans are as 13 to 11 respectively, while the former is also more convenient. The dock pumps include chain, lift and centrifugal types.

GIRDER RAIL WITH CONCAVE BASE.

Girder rails for street railways are being more and more used in this country, and we illustrate this week a rather novel section of grooved girder rail, the base of which is rolled of concave form. The idea of this design is that sand or gravel ballast when well tamped into the hollow will not tend to work away from under the base by the vibration of the rail, the durability and stability of the track being therefore increased. The concave base is also claimed to hold the track in line, and to reduce the general work of maintenance. The radius of the



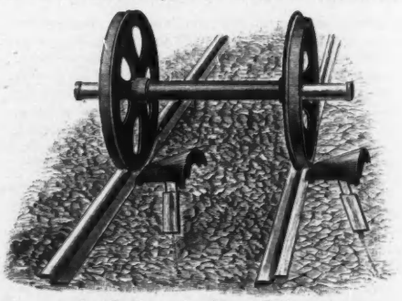
Girder Rail with Concave Base.

under side of the base is about 7 ins., but may be made of any desired radius or form. This type of rail has been brought out by the Gesellschaft fur Stahl Industrie, of Bochum, Germany, and some of the rails have been supplied to Hollmann & Miller, of Buenos Ayres.

Different forms of joints are used with these girder rails, generally in connection with fish plates. In one form of joint the rail ends rest on and are bolted to a base plate of trough section, and the two outer splice bolts pass through the flanged ends of flat tie bars, the rails being laid with even joints. Where no base plates are used, the flat tie bars are sometimes placed between the joints, the ends being turned and threaded and passing through holes in the web of the rails, and being secured by bolts on each side of the web.

CAR REPLACER FOR STREET RAILWAYS.

A car replacer adapted for use on street railways is a very desirable addition to the equipment for this class of railway, and we illustrate herewith a form of replacer for this service which has recently been put on the market by B. E. Tilden & Co., of Chicago, whose wrecking frog for steam railways, as applied for a rerailing device at bridges, was illustrated in our issue of April 11, 1891. The shoes are self-holding and are reversible. An electric switch forms a part of each replacer, so that for rerailing electric motor cars the circuit can be connected by means of the device on the ground.



Car Replacer for Street Railways.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Construction of Grading Contract.

Where, in an action against a city on a contract which required plaintiff to grade a street to the satisfaction of the commissioner of public works, and according to certain plans and specifications, the answer admits that the rock excavation required by the contract has

been completed, and the work accepted by the Commissioner, evidence that the rock has not been excavated as required is inadmissible, and though received, will not be considered, on review, to reverse a verdict for plaintiff by direction. (Brady vs. City of New York, C. of App., N. Y., 30 N. E. Rep., 757.)

Damages For Overflow From Culvert.

In assessing damages to the landowner for right of way taken, regard is had only to the immediate consequences of the appropriation. The owner is not in such proceedings compensated for damages which may thereafter result from negligent acts of the company committed after it makes the appropriation, as from overflows caused by the negligent construction of a culvert. (Hunt v. Ia. Cent. Ry. Co., Supr. Ct., Iowa, 52 N. W. Rep., 668.)

STANDARD COAL CAR; CHICAGO, ROCK ISLAND & PACIFIC RY.

(With inset.)

We illustrate this week the standard coal car of the Chicago, Rock Island & Pacific Ry., which is of modern design, having a capacity of 50,000 lbs. It is a flat bottom gondola car, with plank sides bolted to stakes held in stake pockets. Mr. Voss, in his recent book on "Railway Car Construction," states that the drop-bottom cars, necessitating the use of elevated tracks in coal yards, etc., are almost exclusively used in the East and some portions of the South, but are seldom met with in the West. A natural reason for this is that so much of the Western coal is quite unsuited for dropping out of a dump. The car illustrated is fitted with automatic couplers and hose for continuous brakes, though no brakes are shown on the drawings. Hand brakes are also provided. It will be noticed that the buffing strain is taken up by continuous timbers running the whole length of the car. The trucks are of the diamond pattern with 33-in. wheels. The principal dimensions are given in the accompanying table. Mr. Geo. F. Wilson is Superintendent of Motive Power and Equipment of the road.

	ft.	ins.
Length over sills	36	0
Width over sills	9	0
Length inside body	33	4½
Width inside body	8	0½
Depth inside body	3	3
Total wheel base	30	10
Truck wheel base	5	0
Dist. c. to c. of trucks	25	10
Height from rail to center of drawbar	2	10
Capacity	50,000	lbs.
Weight, empty	26,600	lbs.

THE ENGINEERING SCHOOLS OF THE UNITED STATES.

XVII.

THE DISTRIBUTION OF GRADUATES.

In the accompanying diagram and table (Table XVI.), we show, perhaps, the most striking and important facts which this investigation will develop, viz.: the sudden and amazing increase in mechanical engineering graduates, the relative decline in number of civil engineering graduates, and the great absolute decline in number of mining graduates, which last amounts almost to a complete abandonment of mining engineering as a distinct branch of study.

The causes for this rapid and radical change (the end of which is not yet apparent) are easy enough to imagine after the event, though few might have ventured to predict in advance that such a change was at hand, and fewer still can have known how great the change had been already.

As for mining engineering, what is there about the ordinary work of the ordinary mining engineer which requires a different training from that of a mechanical engineer? Chiefly a certain amount of metallurgical and prospecting or sampling work. But to become a specialist in this kind of work a man should be a chemist and metallurgist at once, and nothing else. After a mine has once been discovered, and its value approximately determined (the doing of which affords steady and profitable work to few or none), the chief work of the mining engineer is to open and operate the mine advantageously; and the knowledge and experience of a civil or mechanical engineer gives just the right preparation for this kind of work. Such is the result in practice, evidently, for mining engineering itself is a rapidly expanding department of professional work, while the number of graduates from mining schools has been steadily declining since it reached its climax (of 61 graduates only), in 1884.

This has been in substance the experience of all the schools alike, and not of one school only, nor is the decrease caused by the abandonment of mining courses at the several colleges, but simply by a decrease in the number of students taking such courses.

This is shown in detail in the accompanying Table XV., giving a substantially complete return of the graduates from all the mining schools of the United States.

The backbone of mining education in this country has always been the Columbia College School of Mines, which is now practically abandoning the special field which its name implies, and turning out large classes in the other branches of engineering instead. In fact, had we taken "the face of the returns" for Columbia, the few "miners" which appear for 1891 and 1892 would not have appeared as such at all. They were returned to us as mechanical engineers with the mining column blank, and perhaps, correctly; but as so complete a change seemed improbable we have included the alleged mechanicals as mining graduates.

As a rule Columbia has turned out each year from half to two-thirds of the total number of mining graduates since it set the fashion of having such a course in 1863-7. It started in with remarkably large classes, which fell off during the panic era of 1873, but sharply recovered up to 1878-85, after which date the turn and permanent decline seems to have begun.

The next most important mining school is the Massachusetts Institute of Technology, which for more than 20 years has managed to graduate a tolerably persistent class of five or six. Lehigh, Washington and the University of California grind out with difficulty a class of two or three yearly. The Michigan Mining School is a promising and vigorous new school, which is likely to graduate a class of 12 in 1893, though special causes, noted last week, are alleged to have caused a decline in the last three years. Whether they really did so, or whether the decline is only another evidence of a general tendency, may be questioned. Five state colleges together, constituting group D of mining schools, turn out an average class of a little over one each! The 15 schools which make up the whole list have averaged from two to three graduates each, only, for 20 years, with no tendency in any one to increase, but rather to fall off!

So much for the mining schools. If there is any real need for them as separate organizations, apparently they are not so organized as to fill that need. It would seem far wiser for most, if not all, of these 15 schools to drop these courses and separate degrees altogether under these circumstances, using the released staff to strengthen their other courses.

The training which they give does not seem to be any special help to a man in entering into mining work. Otherwise the number of graduates would increase at least as fast as the mining interest, which grows prodigiously.

As for mechanical engineering, the increase in number of graduates is, indeed, surprising, and yet, it is an increase that might have been foreseen, and can now be foreseen as likely to gain hereafter as heretofore. For years it has been true, and it must continue to be more and more so, that for his highest success the civil engineer must be more or less of a mechanical engineer also. The field which the civil engineer has exclusively to himself is hardly more than he had a thousand years ago, viz., the simpler types of bridges and roads, and aqueducts. All the vast modern expansions of the field of civil engineering, with hardly an exception, are in the mechanical direction. To lay out a railway intelligently a man should know a good deal of mechanical engineering, which is one of the reasons why so many engineers make such bad work of it. Of modern bridge works this is still more true. The construction and operation of cable and electric railways, pumping works, every department of electric work,

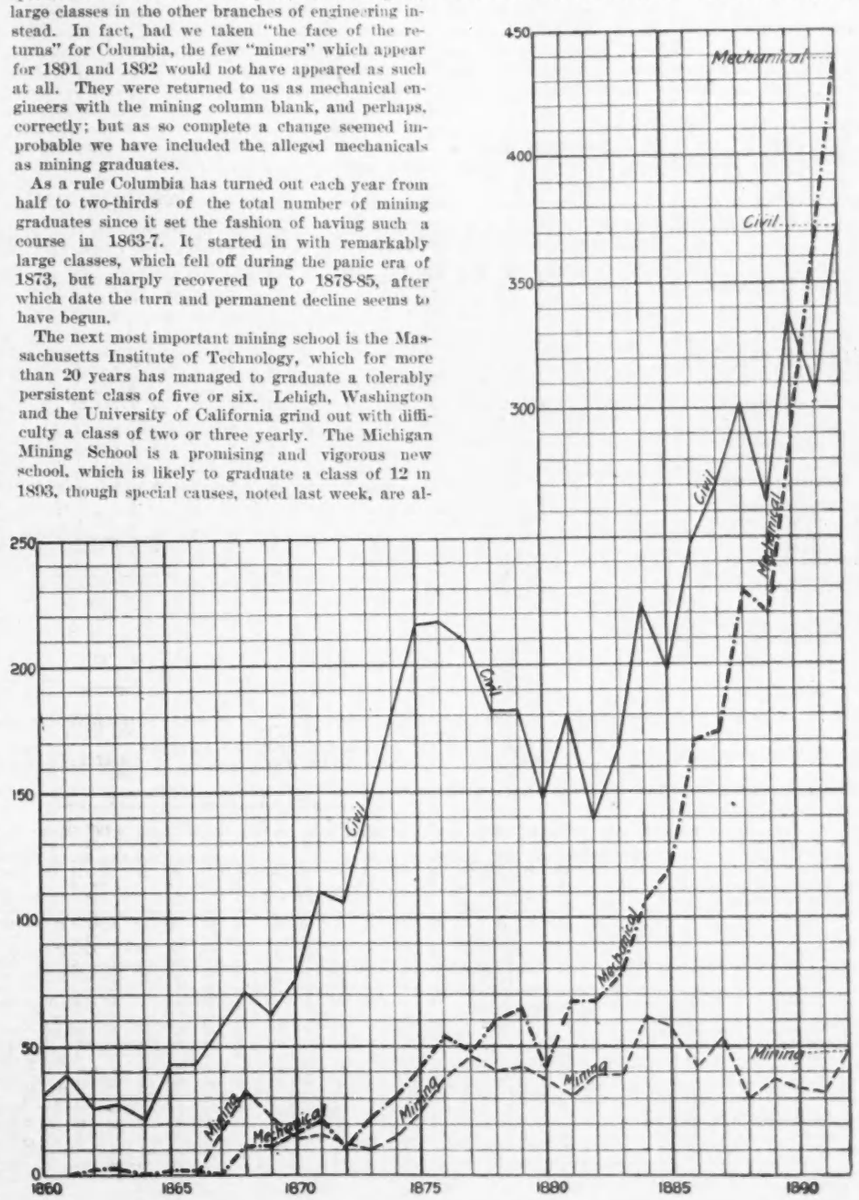


DIAGRAM SHOWING NUMBER OF GRADUATES FROM CIVIL, MECHANICAL AND MINING ENGINEERING COURSES IN THE ENGINEERING SCHOOLS OF THE UNITED STATES FOR EACH YEAR SINCE 1860.

and much of the new profession of sanitary engineering, depend upon mechanical knowledge very largely for successful practice.

While a country is new and raw, as we have already said in substance, the construction of public works and ways of communication makes the special field of the civil engineer (in the narrow sense), the only one of importance; but there comes a time when the major portion of the bridges, roads, railways and water-works are already built, and the relative amount of such work falls off, while the mechanical problems connected with manufacturing, mining and the operation of public works grow daily more important. That era came long since in England; it is now upon us here.

It is easy to trace in the accompanying diagram just when the change began. It was almost coincident with the organization of the American Society of Mechanical Engineers in 1880. For five preceding years mechanical engineering had been relatively gaining, by holding its own in spite of the depression of the times, while the number of civil engineering graduates was declining rapidly. Since 1880 the number of mechanical graduates has increased by leaps and bounds, until it is now 10½ times greater than it was then, whereas the number of civil engineering graduates has increased only 2½-fold. We shall give next week a table showing for 1891 and 1892 only (for which years only we collected the information), just what proportion of the mechanical graduates take an electrical course. They will soon be a full half of the mechanical graduates, apparently.

The increase in the number of civil engineering graduates cannot be small, absolutely, however, though the increase in number of mechanical graduates rather dwarfs it. Going back to another culminating period like that of 1892 (for we take it to be such), in 1873-7, there were over 200 graduates, against a present normal maximum of about 350. That is in more than full proportion to the increase in civil engineering works going on in the respective periods, and is certainly fairly rapid growth, especially if we remember further that in 1873 there were no mechanical engineering schools of much importance, and that many men may have taken the civil engineering course for lack of one more suited to their needs. In fact, the only mechanical engineering school of much importance was then the Worcester Polytechnic Institute. Stevens was just getting ready to begin, and only seven schools had any graduates in mechanical engineering, as will appear from a table to follow. The field for civil engineers is still expanding, and will long do so. Relatively only is it decreasing. One great cause for the increase in mechanical graduates is that, now that there is a supply of educated mechanical men, railways and other like works are demanding them to manage their mechanical departments, instead of giving such positions to the more skilled mechanics.

The first electric street railway in Russia is that recently opened at Kiev, according to the "Zeitschrift fuer Transportwesen and Strassenbau." It was constructed by the "Allgemeine Electricitats-Gesellschaft" in Berlin upon its system of overhead conductors, which is said to have been adopted for electrical tramways in several German cities. Grades of 10% have to be overcome.

The passenger traffic on the Brooklyn Bridge cable railway during July last amounted to 3,137,673 or a daily average of 101,215. The number of cash fares at 3 cts. was 1,630,583, and the number of tickets sold at 10 for 25 cts. aggregated 1,507,090. As compared with the month of June preceding, there was a decrease in the receipts from carriageways of $583 and from the railroad of $4,596, a total of $5,180. The decrease in cash fares was 5,002, in number of tickets sold 177,860, and in the daily average of passengers for July, 9,469. From Brooklyn the receipts for the month were $48,983 and from New York $44,592. The financial statement of the Treasurer, Col. Geo. B. McClellan, for the month of July showed an excess of receipts over expenditures of $10,096. Including ice, the expenditures for the month footed up $85,762, while the receipts were: From carriageways, $6,981; railway, $86,594; material sold, interest, and rent, $2,282; total, $95,858. At the close of the month the treasurer had cash in bank and on hand aggregating $291,860.

The Buenos Ayres Great Southern Ry., in the Argentine Republic, has attained a good standard of excellence in construction, according to the "River Plate Railway News." It has a length of about 1,300 miles,

TABLE XV.—TOTAL NUMBER OF GRADUATES FROM COURSES OF MINING ENGINEERING FOR ALL OF THE FIFTY-TWO COLLEGES LISTED IN TABLES XIII. XIV., HAVING GRADUATES FROM SUCH COURSES, FOR EACH YEAR SINCE THEIR FORMATION.

	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892
6. Univ. of Michigan	2	6	7	3	1	1	....	....	....	....	....	4	3	3	....	....	....	....	....	2	1	1	4	1	....	2
Totals, Group A	2	6	7	3	1	1	....	....	....	....	....	4	3	3	....	....	....	....	....	2	1	1	4	1	....	2
9. Columbia C. Sch. of Mines	14	21	12	9	6	4	5	8	12	16	25	24	19	16	15	20	21	34	37	15	23	7	12	13	5	9
10. Washington & Lee	....	....	4	....	....	....	....	1	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
11. Mass. Inst. Technology	....	6	....	2	5	5	3	1	6	8	8	2	3	3	6	5	5	13	8	7	8	4	5	3	4	6
12. Lehigh University	....	....	....	....	1	....	....	....	1	2	....	1	....	3	1	3	6	4	1	6	6	3	4	....	4	2
Totals, Group B	14	27	16	11	12	9	8	10	22	26	33	27	22	22	22	28	32	51	46	28	37	14	21	16	13	17
17. Lafayette, Pardee Sc. D	....	....	....	....	3	3	2	2	1	5	3	3	1	3	....	1	1	3	1	2	2	....	...	2	(1)	1
18. Washington Univ	....	.. .	....	....	....	....	....	1	1	3	1	1	2	2	4	3	4	4	1	2	3	1	2	3	2	3
22. Ala. Polytechnic Inst.	....	....	....	....	....	....	....	....	.....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	2
Totals, Group C	....	..	....	....	3	3	2	3	2	8	4	4	3	5	4	4	5	7	2	4	5	1	2	7	3	6
25. Univ. of Penna	...	...	....	....	....	....	....	....	...	....	....	....	....	....	....	...	....	....	....	....	....	....	....	....	....	1
27. Univ. of Wisconsin	....	....	....	....	....	....	....	....	....	....	....	....	1	1	2	3	....	....	2	....	2	....	1	....	....	....
31. Univ. of Mo. Sch. of Mines	....	....	....	....	....	....	....	1	1	3	2	2	1	2	1	1	1	2	2	1	2	....	....	....	3	1
32. Univ. of California	....	....	....	....	....	....	....	1	....	....	7	2	9	3	2	2	....	1	4	3	5	1	3	1	6	5
38. Univ. of Illinois	...	....	....	....	....	....	....	....	....	....	....	1	3	1	....	....	....	....	....	....	1	....	....	....	....	....
Totals, Group D	....	....	....	....	....	....	..	2	1	3	9	5	14	7	5	6	1	3	8	4	10	1	4	1	9	7
43. Colorado Sch. of Mines	....	....	....	...	....	....	....	....	....	....	....	....	....	....	...	1	1	....	1	4	....	6	....	2	2	9
49. Michigan Mining Sch	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7	6	7	4	3
52. Montana Sch. of Mines	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	(1)
Totals, Group E	....	....	....	....	....	....	....	....	....	....	....	....	....	....	.	1	1	....	1	4	....	13	6	9	8	16
Grand Totals	16	33	33	14	15	13	10	15	25	27	46	40	42	37	31	39	39	61	57	42	53	30	37	34	33	48

TABLE XVI.—GRADUATES OF THE 52 ENGINEERING SCHOOLS LISTED IN TABLES XIII. AND XIV., SUBDIVIDED ACCORDING TO COURSE OF STUDY BETWEEN CIVIL ENGINEERING, MECHANICAL ENGINEERING (INCLUDING ELECTRICAL) AND MINING ENGINEERING.

(The totals for each group of Table XIV. only are given. Group A consists of the 6 oldest colleges; Group B, of the 8 next oldest; Group C, of 10 colleges; Group D, of 16 colleges and Group E, of the 12 youngest colleges.)

(The totals for 1889, 1890, 1891 and 1892 do not quite agree with those given in Table XIV., owing to the correction of some errors in the latter.)

Group.	Class.	1860	1861	1862	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892
A	Civil	31	39	27	28	22	43	39	50	53	46	45	58	37	57	62	74	73	71	61	55	47	52	40	45	56	75	85	80	75	55	66	69	88
	Mechanical	....	....	2	2	1	2	2	....	10	8	13	9	4	6	6	8	9	7	7	7	9	9	9	10	12	20	21	24	28	26	26	57	58
	Mining	....	....	....	....	....	....	....	2	6	7	3	1	1	....	....	....	....	....	4	3	3	....	...	....	....	....	....	2	1	1	4	1	..	2
	Total	31	39	29	30	23	45	41	52	69	61	61	68	42	63	68	82	82	78	72	65	59	61	49	55	68	95	108	105	104	85	93	126	148
B	Civil	....	....	....	....	....	....	4	7	18	16	21	35	45	54	54	64	57	67	47	47	36	50	34	39	55	41	60	75	101	85	110	88	110
	Mechanical	....	....	....	....	....	....	....	....	1	3	4	3	1	4	4	6	12	6	7	10	2	6	5	14	10	12	39	37	56	52	54	63	80
	Mining	....	....	....	....	....	....	....	14	27	16	11	12	9	8	10	22	26	33	27	22	22	22	22	28	32	51	46	28	37	14	21	16	13	17
	Total	....	....	....	....	....	....	4	21	46	35	36	50	55	66	68	92	95	106	81	79	60	78	67	85	116	99	127	149	171	158	180	164	207
C	Civil	....	....	....	....	....	....	....	....	....	....	10	17	24	32	42	37	46	39	33	34	25	32	27	32	42	40	47	44	48	38	49	40	50
	Mechanical	....	....	....	....	....	....	....	..	....	....	....	10	7	12	15	16	13	22	13	24	16	23	28	24	28	32	39	43	48	45	61	65	73
	Mining	....	....	....	....	....	....	....	..	..	..	....	3	3	2	3	2	8	4	4	3	5	4	4	5	7	2	4	5	1	2	7	3	6
	Total	....	....	....	....	....	....	....	....	..	....	10	30	34	46	60	56	67	65	50	61	46	59	59	61	77	74	90	92	97	85	117	108	129
D	Civil	....	....	....	....	....	....	....	....	....	....	....	....	....	7	23	41	41	32	40	45	38	44	38	48	64	38	52	66	60	54	85	79	73
	Mechanical	....	....	....	....	....	....	....	....	....	....	....	....	....	1	6	12	20	13	33	24	14	19	26	31	57	51	51	61	74	78	123	131	145
	Mining	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1	3	9	5	14	7	5	6	1	3	8	4	10	1	4	1	9	....
	Total	....	....	....	....	....	....	.	....	....	....	....	....	....	8	31	54	64	54	78	83	59	78	70	80	124	100	107	137	135	136	209	219	225
E	Civil	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1	....	2	5	4	3	5	17	32	27	30	50
	Mechanical	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	20	9	23	20	29	50	85
	Mining	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	....	1	4	....	13	6	9	8	15
	Total	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1	1	3	5	7	27	14	53	58	65	88	149
Totals.	Civil	31	39	27	28	22	43	43	57	71	62	76	110	106	150	181	216	217	209	181	181	148	179	139	166	222	198	247	270	301	264	337	306	371
	Mechanical	....	....	2	2	1	2	2	....	11	11	17	22	12	23	31	42	54	48	60	65	41	67	68	79	107	120	170	174	229	221	293	366	439
	Mining	....	....	....	....	....	....	....	16	33	23	14	16	13	10	15	25	37	46	40	42	37	31	29	39	61	57	42	53	30	37	34	33	48
	Grand total	31	39	29	30	23	45	45	73	115	96	107	148	131	183	227	283	308	303	281	288	226	277	246	284	390	375	459	497	560	522	664	705	858

showing an average increase of 80 miles per annum since 1878. For 55 miles from Buenos Ayres the line is double track and ballasted with stone instead of the usual black earth. The terminal station is large and handsome, and both passenger and freight stations are provided with modern labor-saving and other appliances. The suburban stations near Buenos Ayres are neat structures with all necessary conveniences, and at the principal points along the railway ample accommodation has been provided. Signaling arrangements, including interlocking and the concentration of levers in signal-cabins, have been greatly improved; the busier parts of the line are worked on the absolute block system, and the railway is fenced for the greater part of its length. The increase in the distances to be traversed have made it indispensable to run night trains, and the old short four-wheel day cars have been almost superseded by cars on six wheels and on trucks or "bogies," furnished with lavatory and other accommodation, and the night cars have sleeping berths. The cars are well lighted on the Pintsch gas system, and the subject of car heating is likely to be considered, as railway travel, especially at night, is intensely cold during the winter months.

Steel rail manufacture is to be encouraged in the British colonies. The New South Wales Government has decided to call for proposals for 175,000 tons of steel rails to be manufactured in the colony from material obtained within the colony. It is hoped to induce some of the large iron masters of England or Scotland to develop the iron mines of New South Wales and to establish iron and steel works. In our issue of April 11, 1891, we noted a similar proposal for the same quantity of rails, and gave further particulars as to the ores, etc., in our issue of July 11, 1891. Apparently no firm was found willing to invest its capital in developing the colonial iron ore resources, some reasons for which may be gathered from the article on English railway practice in the colonies in our issue of Aug. 4, 1892.

British exports of iron and steel to the Australasian colonies in June, 1892, amounted to 1,625 tons of pig iron, 2,692 tons of bars and angles, 584 tons of railway material, 1,131 tons of iron and steel wire, 888 tons of hoops, sheets, and plates, 2,963 tons of galvanized sheets, 469 tons of tinplates and sheets, and 87 tons of lead.

The English channel bridge scheme, to connect England and France, is still alive, and at a recent meeting of the Channel Bridge & Railway Co. it was stated that the number of piers had been reduced from 121 to 72, and the spans had been increased in size, and would now measure 1,312 and 1,640 ft. alternately from end to end. The system adopted for their construction was of a nature to obtain the utmost security. The construction of the bridge would take only seven years, of which four years would be required for work in the sea itself. In consequence of the increased size of the spans, the new system proposed for lighting the bridge, and a system of buoys, navigation would not be in any way interfered with. The total cost of construction and the interest on the money required during the time of construction has been diminished to $160,000,000. The plans for this bridge were published in our issue of Nov. 2, 1889.

The Otis Elevating Ry., running from Otis Junction, where it connects with the Catskill Mt. Ry., to the top of the mountain near the Mountain House, has been opened for regular freight and passenger traffic. The road is operated by a cable and is 7,000 ft. long, with a total rise of 1,630 ft. The contractors for the grading were Pennell & O'Hern, and for the remainder of the work, with the exception of the boilers and machinery, Mairs & Lewis, of 18 Broadway, New York City. We expect to give a full description of this line in an early issue.

Recent experiments made by U. S. Army officers on pneumatic disappearing gun carriages are said to have been very successful. Pneumatic power has also been successfully applied to the working of ordinary gun carriages. The U. S. monitor "Terror" is now being furnished with such carriages and will also have pneumatic steering, ammunition hoisting and turret revolving plant.

A submerged cable system of steam navigation, similar to that in use on some European rivers is proposed by Mr. Gustave Dyes, of Kansas City, for steamers on the Missouri River.

The percentage of standard safety couplers used on the German railways in 1885, excepting the three South German states (Bavaria, Wuerttemberg and Baden) was 29.79% of the total amount of coupling devices in use. Safety couplers of other systems amounted to 2.28% against 67.93% of the old style screw couplings with safety chains, according to the "Schweizerische Bauzeitung." In 1891 63.95% of the couplers used were of the standard safety type, 0.99% a different kind of safety coupler and 35.06% the ordinary screw coupling. Hence 34.16% of the existing rolling stock has been fitted with standard safety couplers in a term of six years. In Wuerttemberg a coupling which is similar in construction to the standard safety type, is rapidly coming into use. In Baden a number of cars have been furnished with standard safety couplers, with a view of testing their efficiency.

The Transiberian Railway is now well under way and 12,000 men are now employed on the Ussuri Railway, forming the eastern section. Of these 1,300 are convicts, 1,000 exiles, 2,100 soldiers, 300 Russian workmen, and 6,000 Chinese and Coreans. Work is now in progress along the entire line. Everything is ready for the construction of the stations and the fixing of the telegraph posts, and it is expected that 62 miles will be completed this autumn.

In the state of Maine, according to a late census bulletin, 77.9% of the families living on farms own their farm free of all incumbrance; 22.1% own it under a mortgage, averaging about one-third its value, on which they pay 6.26% interest, and only 7.6% rent farms. Of the families living on farms, 48% own their houses and 52% rent them. Of those owning their houses 78.66% do so without incumbrance, and 21.34% have mortgages on which they pay 6.06% as an average. This shows a remarkable condition of prosperity and independence. In Kansas, as many as 33.25% of the farmers rent their farms, and in Ohio, 37.1%.

A survey of the proposed Mombasa Railway, in Africa, has recently been made by Capt. Macdonald, R. E., who has found practicable a line 350 miles long in touch with the centers of population and cultivation, and with a maximum grade of 1.5%. It is estimated that this line can be constructed at a cost of $15,000 per mile.

A Baltimore paper proposes that the city utilize the surplus flow of the Gunpowder River, which furnishes a large part of the city's water supply, for water power to generate electricity for the public lighting. The average flow during the past year was 424,413,638 gallons daily, of which only about 20% is used for water supply purposes. The crest of the Loch Raven dam is 170 ft. above mean low tide. The dam is 18 miles from the Baltimore City Hall. The flow of the river in low water is not stated, but it is probable that an auxiliary steam plant would be necessary if any considerable amount of power were to be developed.

The returns on capital expenditure on Indian railways for the year 1891 were as follows: Standard gage (5 ft. 6 ins.), 5.98% as compared with 5.91% in 1890; meter gage, 5.04%, against 4.31% in 1890; special gages, 5.42%, against 5.05% in 1890. Average of all railways, 5.76% for 1891, against 4.85 in 1890.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

BANGOR & AROOSTOOK.—On account of the late date of beginning work on this Maine railway it will not be attempted to lay any track this season as was first intended, but the grading will be completed as rapidly as possible. About 40 miles of the 93 miles between Brownville and Houlton, Me., are now well under way, and the sub-contracts for the remaining 53 miles will be let soon. North from Houlton the line is under contract and some work may be done this season. It is intended to begin tracklaying early in the spring and complete the Brownville-Houlton section in about three months. Ch. Engr., Moses Burpee, Houlton, Me., Genl. Contr., C. P. Treat, Houlton, Me.

PITTSBURG, CINCINNATI, CHICAGO & ST. LOUIS.—The contract for building the proposed extension of the Cumberland branch has been let to W. F. Patterson, New Cumberland, W. Va.

AKRON & EASTERN.—About 300 men are now at work on the western end of this proposed line from Akron, O., east to New Castle, Pa., about 70 miles, and the section from Akron to Mogadore, O., will probably be completed this year.

PHILADELPHIA & READING.—The Langhorne & Bristol R. R. Co., has been chartered in the interest of this company to build a railway from Langhorne to Bristol, Pa., about 6 miles.

WILMINGTON & NORTHERN.—This company has given a mortgage of $1,000,000, the proceeds to be used in settling the outstanding indebtedness and in improvements.

PROVIDENCE & SPRINGFIELD.—Work will probably be commenced soon on the extension from Pascoag to East Thompson, R. I., 7½ miles. The funds for the extension were secured by a recent sale of bonds.

PENNSYLVANIA.—Under the direction of Ch. Engr. Wm. H. Brown, work is being pushed on the various improvements in track and terminal facilities on the main line between Philadelphia and Harrisburg, Pa. The work consists mostly in building trestles and tunnels to avoid grade crossings, straightening and reducing the grade of the track and otherwise improving the permanent way.—There will be eleven bridges to construct on the Roxborough R. R., the most important of which will be the one over Wissahickon Creek, 564 ft. long and 135 ft. high. The others will be located as follows: Rittenhouse St. immediately after leaving Chelten Ave., Station, bridge 50 ft. long; Lincoln Ave., spanning Paper Mill run and ravine, 350 ft.; Wissahickon Ave., 50 ft.; Wissahickon Valley, including the creek and park drive, 564 ft., and 135 ft. above the surface of the water; Monastery Ave., and a deep depression, 200 ft.; Gorgas Lane, 40 ft.; Fairthorne Ave., 50 ft.; Grease's Lane, 40 ft.; Summit Ave., 50 ft.; new road to Park and Berren Hill, 50 ft., and over the Plymouth Branch road on a bridge 60 ft. long. The road will pass under the following thoroughfares, Roxborough, Leverington and Shawmont aves., Wise's Mill, Township Line, Manatawna, City Line and Spring Mill roads, and the Germantown and Perkiomen turnpike. The contracts for making necessary excavations, constructing the road bed, building the approaches, abutments and piers of the different bridges have been awarded to Keller & Crossan and John T. Dyer. Both have forces of men at work and are bound by the terms of their contracts to have work completed by Jan. 1, 1894. The road will be double-tracked and will have stations at convenient points.

Projects and Surveys.

BINGHAMTON & STATE LINE.—This company has increased its capital stock from $130,000 to $500,000, and there are indications that some definite steps toward construction will be taken soon. Loc. Engr., Chas. W. Sherman, Binghamton, N. Y.

KONKAPOT VALLEY.—This company, which was incorporated some time ago, in Massachusetts, has organized with H. H. Laughaar, President; H. D. Sisson, Clerk, and A. F. Campbell, Treasurer.

TORONTO, HAMILTON & BUFFALO.—The Toronto, Ont., City Councils have passed a by-law granting this company a bonus of $225,000, which will be voted upon Sept. 2. The law provides that $225,000 will be paid when the line from Welland Junction, via Brantford to Waterford, Ont., is completed and the remaining $50,000 when the branch from Hamilton to Toronto, Ont., is completed. This line was surveyed in 1889 and several efforts have been made to secure its construction, but as yet these have not been very successful.

WASHINGTON & CHESAPEAKE BEACH.—The contract for building this line from Washington to Chesapeake Beach, 30 miles, has been let to Neale & Co., of Pittsburg, Pa. Ch. Engr., L. H. Hyer, Washington D. C.

PENNSYLVANIA, LEHIGH & EASTERN.—This company has been reorganized and a new Board of Directors chosen, with David A. Easton, of New York, Pres.; W. J. Highlands, of Cleveland, O., Vice-Pres., and S. H. Nichols, of Philadelphia, Sec. and Treas. Mr. Easton says that the delay so far in building the road, which is to extend from Tomhicken, Pa., to Port Jervis, N. Y., in the Lehigh anthracite coal region, a distance of 100 miles, has been due to a number of litigations over the old charter under which the road is to be operated, and which was acquired in 1889. These litigations are now settled, and negotiations are already afoot with some New York bankers, by whom money will be supplied to begin work on the road at once. The main line of the road is to connect at Fort Jervis with the Erie, and go over the Poughkeepsie bridge. When finished, the road, it is said, will make the shortest line by 50 miles between the anthracite coal region and New England. It will also connect with the New York, Susquehanna & Western at Gray Iolace and thus give tidewater entrance into New York for coal and traffic purposes. Ten miles of the road on its eastern end are partly graded.

Southern.—Existing Roads.

POTOMAC, FREDERICKSBURG & PIEDMONT.—This company will, it is stated, build a branch to Chancellorsville, Va.

ABINGDON COAL & IRON.—The grading has been completed on the section of this line between Abingdon and Damascus, Va., 15 miles. Surveys are now being made for a line to Mountain City, Tenn.

WEST VIRGINIA CENTRAL & PITTSBURG.—Surveys are reported begun for a line from Beverly, W. Va., up Tygart's Valley to Mingo Flats and thence to Marlington, W. Va.

BRISTOL, ELIZABETHTON & NORTH CAROLINA.—The 26-mile section of this road from Bristol to Elizabethton, Tenn., has been completed.

MIDDLE GEORGIA & ATLANTIC.—The "Manufacturers' Record" says: "A syndicate will be formed by parties interested in the Middle Georgia & Atlantic R. R. to furnish the $175,000 required to complete it from Machen to Eatonton, Ga. William Garrard, of Savannah, can give particulars."

CHARLESTON, SUMTER & NORTHERN.—The extension from Bennettsville to Gibson Station, S. C., 11¼ miles, will soon be completed and in operation.

CINCINNATI SOUTHERN.—This company is said to have under consideration an extension from Chattanooga, Tenn., to Savannah, Ga., about 275 miles.

Northwest.—Existing Roads.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE.—This company expects to lay 120 miles of new track in North Dakota this year; 108 miles from Valley City northwest and 12 miles from Merricourt, N. Dak., northwest. There remain only about 150 miles to carry the Valley City line to the Canadian boundary.

CHICAGO GREAT WESTERN.—A press dispatch from Chicago says: "Plans are under consideration by the directors of the Chicago Great Western Ry. Co., lessee of the Chicago, St. Paul & Kansas City, whereby it is proposed to extend its system by building a line to Omaha. Such an extension has been talked of for more than a year, but prior to the organization of the company and the increase in the capital stock the financial condition of the road was such that Chairman Stickney did not see his way clear to an early realization of his dream. Now, with fresh millions at his command, it is understood that the line to Omaha will certainly be constructed, and that it is the intention of the management to have it completed and open for traffic long before the opening of the World's Fair. In fact, the present plan is to have it in operation as early as next Christmas if arrangements can be made to begin the work without delay, and it is proposed that the new line shall connect with the present system at a point about 15 miles south of Des Moines. This will necessitate the building of about 90 miles of road, and when this is completed the Chicago Great Western will have the short line between Chicago and Omaha, the whole length of it being a little over 490 miles.

DES MOINES & KANSAS CITY.—This company has given a mortgage of $2,000,000 to the Massachusetts

Safety Deposit Co., the proceeds to be used in making improvements.

CHICAGO, BURLINGTON & QUINCY.—A press dispatch from Chicago says: "In anticipation of an increased business next year the Chicago, Burlington & Quincy R. R. Co. intends to expend from $10,000,000 to $12,000,000 this year in extensions and new equipment. Of this amount, $1,000,000 will go into a new bridge and greatly enlarged terminal facilities at St. Louis. Two new iron bridges, each costing $43,000 more than the old structures they replace, are being erected on the northern branch; $100,000 will be spent on an enlargement of the company's Chicago freight house. In Northeastern Wyoming the most important and costly extensions are being made, one line running northwest of Sheridan, and another southwest through the Powder River country toward Ogden. The contract for new equipment includes 50 locomotives, 59 passenger cars, 55 chair cars, 1,000 stock cars, 1,000 coal cars and 200 furniture cars."

CANADIAN PACIFIC.—The contract will soon be awarded to build the branch from Regina, N. W. T., to the international boundary to connect with the Minneapolis, St. Paul & Sault Ste. Marie Ry.

DULUTH, PIERRE & BLACK HILLS.—Contracts for grading the line from Aberdeen to Pierre, S. Dak., have been let and it is now thought the line will be rapidly pushed to completion.

Projects and Surveys.

ILLINOIS & IOWA TERMINAL.—At a recent meeting of the directors of this company Ch. Engr. Baker submitted a report of the survey from Davenport to Moline, Ia. The distance from the proposed terminus opposite Moline and the union tracks at Clinton is 28 miles, and the cost of the road with iron bridges and stone piers is estimated at $338,000, and with combination bridges and piling, at $387,000. This includes grading and putting ties and iron on, but nothing more. The secretary was instructed to take immediate steps to secure right-of-way to Clinton and a tax levy in Pleasant Valley, LeClaire and Princeton townships.

ILLINOIS RY. CONS. CO.—Chartered in Illinois with a capital stock of $1,000,000 by Wm. E. Shaw, John M. Armstrong and Wm. P. Dewey, Jr.

Southwest.—Existing Roads.

KANSAS CITY, NEVADA & FT. SMITH.—Grading has been begun on the extension from Hume to Clayton, Mo., about 18 miles. It is intended to have this section completed by Oct. 1. Surveys are now in progress from Clayton to Pittsburg, Kan.

ST. LOUIS, ALTON & SPRINGFIELD.—At a meeting of the stockholders, recently held, it was decided to borrow $1,250,000 to build extensions from Bates to Springfield, Ill., and from Alton to East St. Louis, Ill.

ST. LOUIS UNION DEPOT.—The work of clearing the ground for the large terminal station at St. Louis, Mo., is making good progress now, although considerably delayed by the bad weather, and it is expected to have the building completed by Nov. 1. It will then take about three months to lay the tracks and complete everything ready for business. A full description of the work will be found in our issues of Oct. 3, 1891, and April 2, 21 and 28, 1892.

CHICAGO, ROCK ISLAND & PACIFIC.—The contract for building 35 miles of the Southern extension from the Red River south has been let. A press dispatch says: "Work between Red River and Bowie is progressing as fast as men and money can make it, and the 24 miles of road is covered with men and teams. At least 3,500 men are at work, including about 2,000 teams and scraper holders. The first few miles of road from Red River are very heavy owing to the broken condition of the ground, and numerous deep cuts are being made. The heaviest part of the work is being done by Contractor Wear. Sheridan Bros. have the next few miles and M. Neely & Co. the third division. Work is well under way on the bridge over Red River, and the road will be completed as far as Bowie, so far as grading is concerned, in less than 60 days. The whole 24 miles is covered with camps about two miles apart, and the scene is a busy one. M. Neely & Co., Creech Murphy, Craney Bros. and Mr. Callahan also have contracts. Mr. Callahan has charge of the work running into Bowie."

KANSAS CITY, WATKINS & GULF.—It is reported that this company is preparing to extend its line south to Calcasieu Pass.

MISSOURI, KANSAS & EASTERN.—Asst. Supt. D. M. Wheeler, St. Charles, Mo., writes us that 10½ miles of track have been laid from Hamburg to near Augusta, Mo., since Jan. 1, 1892, and that construction is in progress from Augusta to New Franklin, Mo. There is a 500-ft. tunnel through solid limestone rock at Rockport, Mo.

Projects and Surveys.

ALEXANDRIA & ST. LOUIS.—Chartered in Louisiana by F. G. Hudson, John P. Parker, L. D. McLain, A. C. Hough, W. A. Bright, R. B. Blanks, and I. J. Newton, all well known business men of Monroe. The road is to begin at a point on the line of Louisiana & Arkansas, in Morehouse Parish, and will run southwest through the parishes of Morehouse, Ouachita, Caldwell, Catahoula, Grant and Rapides to Alexandria, La., with a branch line from Monroe through the parishes of Ouachita, Jackson, Caldwell, Catahoula, Winn, Grant, Natchitoches, Rapides, Sabine, Vernon and Calcasieu to a point on the Texas line.

SPRINGFIELD, YELLVILLE & WHITE RIVER.—A press dispatch from Springfield, Mo., dated Aug. 1, says: "The mass meeting held at the Court House here to-night to discuss the Southern railway enterprise was attended by most of the business men of Springfield. Speeches on the resources of the Southern border of Springfield's commercial territory were made by Judge L. L. Hunt, J. M. Bouslog, A. W. Older, R. L. McElhaney, Cyrus Peabody, Capt. George M. Jones, F. J. Underwood, G. A. Ramsay, A. J. Eisenmayer and others. Hon. W. E. Winner, who is now building a railroad from Buffalo Shoals, on White River, Marion County, Ark., toward this city, made a proposition to the meeting offering to connect this route with Springfield for a bonus of $100,000. About four miles of the road has already been graded. The proposed route would run the road through Taney Co. and the eastern part of Stone Co., thus giving Springfield access to that large area of country on White River now traversed only by freight wagons. A committee composed of Geo. M. Jones, Chas. A. McCann, G. D. Milligan, A. W. Otis and G. A. Ramsey was appointed to confer with Mr. Winner in reference to his proposition."

Rocky Mt. and Pacific.—Existing Roads.

NORTHERN PACIFIC.—It is stated that this company, which has been doing a large amount of new construction in the Pacific northwest during the past two years, will stop all new construction after the completion of the Chehalis-South Bend line and will devote its attention to improvements on its existing roads. Only a few miles of the South Bend line remain to be graded and over one-half of the track has been laid. At some future time it is probable that the original plan of building from Yakima, Wash., eastward will be taken up again, but this will not be for some time. The improvements which have been recommended for the Pacific and West Cascade divisions include the erection of new bridges over Stuck, White, Green and Black rivers.

SANTA FE, PRESCOTT & PHOENIX.—A press dispatch from Phoenix, Ariz., says: "W. L. Vail has just returned from the work on the North and South road and says that the work is being pushed as rapidly as possible. The line from Ash Fork to Prescott is permanently settled and the grading will be completed by Aug. 15. Mr. Vaughn, Ch. Engr., says they will be running into Prescott by Sept. 1. By the time cool weather sets in they will be ready to begin on the desert portion between this city and Prescott. Several surveys have been made, and Engineer Vaughn says the best one will be taken when the tracklaying is completed into Prescott. He things the road will be completed by January 1. Lantry & Sons, of Denver, have the contract.

Projects and Surveys.

CANADA WESTERN.—A dispatch from Victoria, B. C., says: "Friday evening Theodore Davis, Premier of British Columbia, entertained Frank Bakeman, Judge Blackman and Colonel Kane, of Chicago, at a dinner given on account of the successful conclusion reached between Bakeman and his associates and by the Government for building the Canada Western Ry. This road will extend from Victoria to Seymour Narrows, on Vancouver Island, crossing to the mainland by a bridge or ferry. Surveys have been made for the Canadian Pacific by way of Bute Inlet to the eastern boundary of the province, at Yellow Head Pass, Rocky Mountains, there to connect with the line now being built through the Canadian Northwest. The Government has already subsidized the road with 20,000 acres a mile. It is also understood that the Government has agreed to aid in the construction by means of guaranteeing interest. Victoria will also aid the scheme.

FLORENCE, CRIPPLE CREEK & STATE LINE.—The arrangements are about completed for beginning construction on this railway from Florence, Colo., to the Cripple Creek mines. An official is reported as saying that there is scarcely a doubt but that work will be started up on the enterprise in 20 days and that the company has practically arranged for the grading of the first ten miles of the road, including the building of the bridge which is to span the Arkansas River.

SAN FRANCISCO & DENVER.—Chartered in California to build a railway from a suitable point on San Francisco Bay, in Alameda, Co., in a general eastern and southern direction, to a convenient point on the state line between California and Nevada. The length of the proposed road is estimated at 300 miles. The capital stock is fixed at $12,000,000, of which $300,000 has already been subscribed. The directors all live in San Francisco, Cal.

CORINNE, MALAD VALLEY & NORTHERN.—At a recent meeting of the directors of this company the following officers were elected: Francis E. Roche, Pres.; L. D. Zonor, Vice-Pres.; Tom D. Pitt, Sec. and Treas.; A. C. Sloan, Asst. Sec., and Robert S. Guthrie, Asst. Treas. The Board of Directors ordered an issue of $700,000 of first morgtgage bonds to complete and equip the line as far as Malad City, Idaho; $450,000 of these bonds have already been placed. Immediately after the harvest the land between Corinne and Malad City will be cross-sectioned and grading will commence from both ends. The corps of engineers sent out under the supervision of C. H. Nicholet, Ogden, Utah, to make the preliminary survey of the route between Corinne and Malad City, Idaho, have returned. They report the distance to be about fifty miles and the entire length of the line over a level country. The grade would not cost more than $800 per mile, as there are no fills or cutts of any consequence to be made.

Foreign.

MEXICAN INTERNATIONAL.—The spur at Pedracines to the Viladan mines, five miles from the International, on the Durango extension, has been furnished and a contract has been entered into between the owners of the mine and the railway for the shipment of twelve car loads of ore per day through Eagle Pass to the smelters in the United States. There are between 1,000 and 1,200 cars of ore at present on the dump and the company has now at work between 300 and 400 miners taking out ore. This mining district is about 40 miles south of Torreon and new rich discoveries are being constantly reported. Work on the Durango extension will begin this week and it is expected that the track will reach the city of Durango by Sept. 1.

COLOMBIA.—The Bureau of American Republics is informed that the agent sent to Europe by the Colombian Government, for the purpose of contracting for the construction of the Antioquia Ry., has successfully executed his commission, and is now on his way home. The contract was made with the firm of Punchard, McTaggart, Lowther & Co., of London, and it is stated that active work will be commenced on the proposed line, and also the reconstruction of the section now in existence between Puerto Berrio and Pavis, as soon as the Departmental Government ratifies the contract. The maximum term granted for the completion of the work is four years from the time of commencement. The railway, from its inauguration, will be the property of the Departmental Government, which does not grant to the constructors anything that resembles a monopoly, franchise or onerous privileges, land grants, etc. The obligations of the government are limited to certain and determined payments, which reduces the matter to a purely commercial transaction. The contract further stipulates that all differences that may arise shall be submitted to arbitrators to be named by both sides. The work itself will be guaranteed, so far as technical perfection in all its details, by a consulting engineer representing the government.

ELECTRIC RAILWAYS.

JOHNSTOWN, N. Y.—The contract for the complete construction of the Cayadutta Electric Ry., to connect Fonda, Johnstown and Gloversville, has been awarded to H. Ward Leonard & Co., New York, including grading, roadbed, power station, steam plant, electric generators, overhead work, cars, etc. The road will be 17 miles long, paralleling a steam railway, and is to be in operation by December. The contract is for $300,000.

YORK, PA.—The street railway is preparing to change from horse to electric traction, using the overhead system. J. G. Durbin, Cy. Engr.

SOUTH CHICAGO, ILL.—The South Chicago City Ry. will be a double track line 12 miles long to the World's Fair, and will be in operation in October. It will be laid with girder rails and equipped with Pullman cars and Westinghouse Electric & Mfg. Co.'s motors and overhead appliances.

VICKSBURG, MISS.—An electric railway franchise has been applied for by R. G. McFarland, J. P. Roach and J. B. Mattingly, of Vicksburg, and E. F. Fuller, of New York.

LEAVENWORTH, KAN.—Leavenworth Electric Transit Co.; $500,000; S. F. Neely, S. Hartough and W. C. Hook, of Leavenworth; L. E. Erb, Kansas City, Kan.

EL PASO, TEX.—The El Paso Electric Co. will build an electric road, and the El Paso Street Ry. Co. and Santa Fe Street Ry. Co. will adopt electric traction.

RENO, NEV.—Reno Electric Ry. & Land Co.; $200,000; F. G. Newlands, C. T. Bender and T. K. Stewart.

MONTREAL, QUE.—The Montreal Passenger Ry. Co. has awarded a contract for 25 HP. motors for 80 cars to the Royal Electric Co., of Montreal.

HORSE AND MOTOR RAILWAYS.

ATLANTA, GA.—A dummy line to Decatur is to be built shortly. Mr. Clyde Brooks is attorney for the new company.

COLUMBUS, O.—Franchises have been granted to the Leonard Avenue Ry. Co. and the Columbus & Westerville Ry. Co. The tracks are to be 5 ft. 2 ins. gage, laid with 70-lb. rails, and 4 ft. between double tracks. Electric traction may be used.

HIGHWAYS.

NEW YORK.—Macadamized roads are being built in Middlesex Co., and this year an appropriation of $40,000 was made for road purposes.—The Town Board of Middletown, Staten Island, has voted to issue bonds for $10,000 for road work.

NEW JERSEY.—Proposals for grading, regulating and improving a new county road in Hudson Co., including culverts, sewers, drains, catchbasins, etc., to dispose of the surface water, will be received until Aug. 18 by J. Boyd, Clerk of Board of Freeholders, at Jersey City. Plans and specifications may be seen at the office of the engineer in the Fuller Building, Jersey City.

MISSOURI.—Deputy County Surveyor Fred. J. O'Flaherty, of Kansas City, has submitted to the county court an estimate of the cost of macadamizing the Kansas City and Raytown road from Leeds to Raytown, a distance of 3½ miles, on a roadbed 18 ft. wide. The surface includes 12,358 sq. yds. The approximate cost is $1.23 per sq. yd., or a total of $15,200, one-fourth of which must be paid by the property owners along the line.

OHIO.—Contracts for 12.54 miles of turnpike road will be let Aug. 19 by J. B. Walsh, Surveyor of Auglaize Co., Wapakoneta, O.

BRIDGES, TUNNELS AND CANALS.

BOSTON, MASS.—A new bridge will probably be built to take the place of the present structure connecting Boston with Charlestown.

PROVIDENCE, R. I.—The Common Councils have appriated $70,000 to provide for the construction of a new bridge at Washington St. The bridge will have a total length of 132½ ft., and will consist of four spans supported on masonry piers. It will have a 40-ft. roadway and two 8-ft. sidewalks. The estimated cost of the structure is as follows: Abutting walls, $21,000; piers, $13,500; superstructure, $26,000; removal of old bridge, dredging, etc., $25,000, and 10% additional for contingencies.

JERSEY CITY, N. J.—Bids will be received until Aug. 18, for building the highway bridge over the Hackensack River at the foot of Newark Ave.

CLEVELAND, O.—Bids will be received until Aug. 17 for a 66-ft. span plate girder bridge at Swiss St. R. H. Herrick, Dir. Pub. Wks.

COLUMBUS, O.—Bids will be received until Aug. 19 for building a four-span plate girder bridge, 88 ft. long, 36-ft. roadway, two 8-ft. sidewalks, over the Scioto River at Town St. Henry J. Caren, Co. Aud.

FLINT, MICH.—Bids are asked for the construction of a stone bridge at Court St.

LOUISVILLE, KY.—The Mayor has signed the ordinance for the viaduct over Kentucky Ave. It will cost $50,000, and work will begin at once.

WATER-WORKS.

New England.

LAWRENCE, MASS.—The State Board of Health has recommended that a filtering plant be put in. Cy. Engr., A. D. Marble will make plans. Probably a filter bed will be constructed.

WINSTED, CONN.—The borough has voted to accept the bequest of the late Wm. L. Gilbert, of $48,000 to connect Mad River and Rugg Brook by a tunnel with Crystal Lake. The sum of $75,000 was voted by the borough to raise the level of Crystal Lake and connect it by a conduit with Highland Lake.

CUMBERLAND, ME.—The people will vote on issuing $100,000 of bonds for improvements and extensions.

Middle.

FAYETTEVILLE, N. Y.—Bids for building works will be received until Aug. 18 by the Water Commissioners.

MOUNT VERNON, N. Y.—A 200,000,000-gallon storage reservoir is to be built. Engr., J. M. Howells, Chicago.

OAKFIELD, N. Y.—Works are talked of.

PLATTSBURG, N. Y.—Bids for water storage and road systems for the Plattsburg Barracks are wanted until Aug. 29. Address Captain Geo. E. Pond, Assist. Q. M., U. S. A.

POUGHKEEPSIE, N. Y.—The Council has authorized the Water Board to buy pumping engines and boilers and make changes in buildings at a cost of $36,000.

SOUTH FORK, PA.—The South Fork Water Co. has been incorporated; $15,000; Treas., E. S. Grumbling.

WEISSPORT, PA.—The Lehighton Water Co., Howard Seaboldt, Secy., may extend its mains here.

PERRYVILLE, MD.—The Perryville Water Co. has been incorporated; $18,000; Jacob Tome, Port Deposit, J. M. Thomas, Philadelphia, J. P. Wright, Perryville, and others.

WASHINGTON, D. C.—The District Commissioners will receive bids until Aug. 18 for cast iron water pipe and special castings.

Southern.

ASHEVILLE, N. C.—The contract for pipe and laying has been awarded to M. H. Kelley for $42,000 and for pumping machinery to H. R. Worthington for $19,890.

WEST KNOXVILLE, TENN.—Works are to be built in accordance with plans and specifications prepared by G. W. Sturtevant, Jr., C. E., Chicago. Water will be the Ayer company, as stated last week. The capacity There will be 14 miles of 6 to 14-in. mains, and 86 hydrants.

North Central.

MADISONVILLE, O.—Bids are wanted until Sept. 3 $15,000 5% 20-30-year water bonds. Bennett Carter, Village Clk.

CLEVELAND, O.—Bids are wanted until Aug. 23 for for 15,000,000-gallon pumping engine. R. Horrick, Dir. Pub. Wks.

ST. MARY'S, O.—There is talk of building private works.

PORTLAND, IND.—The Portland Water Co. has been incorporated; $125,000; Directors, T. D. Glassner, J. W. Gardiner and others.

SOUTH BEND, IND.—Engr. C. B. Davis, Chicago, has recommended that the works be remodeled at an estimated cost of $225,000. The principal improvements would be the relaying of some 12 miles of old Wyckoff pipe with cast iron, and the addition of several miles of cast iron pipe.

BENTON HARBOR, MICH.—Aug. 15 the people will vote on issuing $21,000 of bonds, about $11,000 of which will probably be used for extensions to the mains.

CADILLAC, MICH.—A 30-years' franchise has been granted to W. W. Cummer, who proposes to buy and improve the present works.

CONSTANTINE, MICH.—Aug. 15 the people will vote for or against works.

IONIA, MICH.—A small reservoir is proposed.

JACKSON, MICH.—An 8,000,000-gallon Gaskill pump has been contracted for; price, $30,000.

CENTRALIA, ILL.—The people have voted bonds for works.

EFFINGHAM, ILL.—L. H. Bissell informs us that the people have voted against town works and that probably the Council will grant a franchise in September.

MARSHFIELD, WIS.—The Marshfield Water, Electric Light & Power Co. has been organized to build works. The supply will be pumped from wells sunk in gravel one mile from the city to a 15 × 120 ft. standpipe. There will be six miles of 12 to 4-in. mains, 65 hydrants, two 1,500,000-gallon compound engines and two 100 HP. boilers. The works will be owned and maintained by W. H. Upham, Marshfield, and Moffett, Hodgkins & Clarke, Syracuse, N. Y. W. H. Fritchman will have charge of construction.

McKEESPORT, PA.—The Board of Water Commissioners will receive bids until Aug. 16 for laying about 1,501 ft. of 6-in. and 4,300 ft. of 4-in. pipe.

Northwestern.

VAIL, IA.—Works are again projected.

BUTTE, MONT.—Cy. Clk. John McCrimmon informs us that the City Council has postponed the date for receiving bids for a franchise until about Sept. 7.

NEENAH, WIS.—Bids for constructing works will be received until Aug. 23. Engineer, George W. Sturtevant, Jr., Chicago. See advt.

GRUNDY CENTER, IA.—The people have voted $11,000 for works.

DEXTER, MINN.—Works are wanted.

RONCRAFT, NEB.—Aug. 15 the people will vote on issuing bonds for works.

ELGIN, ORE.—A preliminary organization for a water company has been effected as follows: Pres., D. Sommer; Secy., C. H. Marsh; Treas., Dr. W. E. Brownell.

NORWAY, MICH.—The contract has been awarded to the Michigan Pipe Co. for the construction of waterworks complete, including all material and machinery. The work will be done under the personal supervision of Mr. G. L. Wells. There will be two Deane compound pumping engines, and the Galvin hydrants and valves will be used.

MUSKEGON, MICH.—The Board of Public Works will receive bids until Aug. 22 for three sets of pumps and machinery, including two Flander's duplex pumps, capacity, 1,500,000 gallons each; two Walker pumps, 750,000 gallons each; two Wolverine pumps, 350,000 gallons each.

Southwestern.

KIRKWOOD, MO.—There is talk of supplying this and other suburbs of St. Louis with water to be bought from that city.

LITTLE ROCK, ARK.—The Council has granted the Home Water Co. a new franchise which provides for ten miles of new mains and 162 new hydrants.

GIDDINGS, TEX.—The "News" advocates the building of works.

Pacific.

COLTON, WASH.—The Council has arranged preliminaries for the building of works.

PALO ALTO, CAL.—The Mountain View Water Co. has been incorporated to supply Mayfield, Mountain View and Palo Alto; $500,000; Directors, Christian F. Ruppel, San Francisco, Bradford W. Smith, Oakland, Otto Arnold, Ocean View, and others.

OGDEN, UTAH.—The South Ogden Water Co. has been incorporated; $500,000; Pres., Wm. J. Stephens; secy., Sidney O. Stevens.

HARLEM, MONT.—Bids will be received until Sept. 1 for constructing a water system, or sinking an artesian well at Fort Belknap Agency. The proposed work includes the excavation of trenches, furnishing and laying of iron pipe, construction of a reservoir, etc.; also furnishing all labor and material and sinking a 6-in. artesian well. Archer O. Simons, U. S. Indian Agent.

KALISPELL, MONT.—Works are to be established. Water will be pumped from gravel beds near the confluence of Spring Creek and Whitefish River to a 25 × 50-ft. standpipe. There will be about 8 miles of 12 to 6-in. mains, and 65 hydrants. Estimated cost, $130,000. Engr., Chester B. Davis, Chicago.

Canada.

STELLARTON, N. S.—The lowest bid for the construction of works was made by McDonald, McKinnon, McLean & McDonald, of New Glasgow and Charlottetown, P. E. I., and was about $25,000.

ALLISTON, ONT.—It is reported that this place will have works.

WIARTON, Ont.—Bids are wanted until Aug. 17 for the extension of the intake pipe 1,300 ft. further into Colpoy's Bay and for the construction of a well at the pumping station. T. D. Galloway, Village Clk.

SEWERS.

WESTBORO, MASS.—In 1886 the Massachusetts Drainage Commission, in its report to the legislature upon a general system of drainage for the valleys of the Mystic, Blackstone, and Charles rivers, recommended that the sewage of this town be disposed of by intermittent, downward filtration, upon an area of land located west of the town, and upon the banks of the Assabet River, where by excavating 33,000 cu. yds. of gravel a level area of ten acres could be obtained. C. A. Allen, Cy. Engr., Worcester, has recently reported upon the question and recommended that about five acres be prepared, at an estimated expense of $12,000. The town has voted to prepare two acres and incidentally a third for immediate use.

WINCHESTER, MASS.—The Sewer Committee, composed of D. W. Pratt, C. E., J. R. Freeman, C. E., and H. C. Miller, has reported against the incorporation of the Mystic Valley sewer into the proposed Metropolitan system for the following reasons, each of which is explained in detail: (1) It appears to be not large enough. (2) It is at an elevation too high to properly drain buildings on large tracts of land near the center of the town. (3) It cannot be considered as properly designed, located or constructed according to the best methods existing at the present time, or equal to the remainder of the metropolitan sewerage system. (4) Winchester, at the bottom of the hill, may have many houses damaged and made unhealthy by backflowage from any excess of sewage poured forth by Woburn and Stoneham at the top of the hill, into a sewer too small to carry it. (5) Its adoption may involve many legal complications. A town meeting was held Aug. 8 to consider the question.

PAWTUCKET, R. I.—The Sewer Commissioners have recommended the purchase of 6½ acres of land to temporarily care for the dry weather flow of the sewage of the Moshassuck Valley, and the immediate purchase of 200 acres on Seekonk Plains to permanently care for the entire sewage of the city.

WILLIMANTIC, CONN.—The Sewer Committee will receive bids until Aug. 16 for about 3,170 ft. of 6 and 8-in. vitrified pipe sewer, the borough to furnish the pipe.

CHAUTAUQUA, N. Y.—The report of Samuel M. Gray, Providence, R. I., has been adopted, and the Board of Trustees has ordered the construction of the proposed system.

JAMESTOWN, N. Y.—The Council is considering the sewer plans referred to more fully in our issue of July 28. The separate system is recommended, and it is proposed to issue bonds to pay for the main sewer and assess the cost of the laterals against the benefited property.

NEW ROCHELLE, N. Y.—A special election will be held Aug. 23 to vote on the issue of bonds for $75,000 to complete the sewer system of the village.

PLATTSBURG, N. Y.—Bids will be received until Aug. 29 for a sewer system and construction of roads at Plattsburg Barracks. Capt. Geo. E. Pond, Asst. Q. M., U. S. A.

ORANGE, N. J.—The contract for the northern section of the sewerage system has been awarded to the Delafield Construction Co., New York, at about $84,000.

WEEHAWKEN, N. J.—The Town Clerk will receive bids until Aug. 15 for a brick sewer.

CORRY, PA.—Work on the sewers, which has been suspended on account of legal defects in the assessment plan, is expected to be resumed soon. Robt. H. Wilson, Saltsburg, is the engineer in charge of the work.

WILKINSBURG, PA.—Bids will be received until Aug. 19 for a sewerage system. Edeburn & Cooper, Borough Engrs.

WASHINGTON, D. C.—The District Commissioners will receive bids until Aug. 16 for constructing sewers, catch basins, etc.

NEW ORLEANS, LA.—The company to which the Council has awarded a sewerage franchise, has engaged Rudolph Hering as Consulting Engineer and Geo. G. Earle, recently of the firm of Williamson & Earle, Montgomery, Ala., as Chief Engineer of the Works. Topographic and hypsometric surveys are new in progress.

NEW ORLEANS, LA.—L. W. Brown, Cy. Engr., writes us as follows: "The preliminary survey for the purpose of formulating plans for an extended system of sewerage is now in progress in this city. Actual work on the system has not as yet started and will not for some time. We are also agitating an improved system of drainage. Our locality here is very flat and low, so that a combined system of drainage and sewerage could not be economically employed. Furthermore, the area of our city is very extensive. Our drainage system is very bad and needs much improvement. We are also making very extensive improvements on the wharves in front of the city, and are constructing for the purposes of commerce along the wharves a roadway of Belgian block on concrete base. We have under contract some 30 miles of street to be paved with gravel."

CANTON, O.—The contract for the construction of sewerage disposal works has been awarded to McKinney & McNichols, at $12,928.

CONNEAUT, O.—The sewer contract has been awarded to J. D. Sullivan, Erie, Pa., at $26,448.

FOSTORIA, O.—Bids will be received until Aug. 27 for sewers in two districts. J. P. Force, Cy. Engr.

TOLEDO, O.—The Sewer Committee has approved resolutions for sewers in 15 streets. The City Clerk will receive bids until Aug. 23 for a 24-in. brick sewer.

ZANESVILLE, O.—The City Clerk will receive bids until Aug. 29 for two sewers.

WEST DULUTH, MINN.—The City Engineer has completed plans and specifications for the central sewer district. The plans provide for about 19 miles of sewer pipe and the estimated cost is $230,583.

SIOUX FALLS, S. DAK.—D. C. Rice, Cy. Engr., writes us as follows: "The city expects to commence on our system of sewerage, as planned by Mr. Hering, and put in as much of it as will be covered by paving this year, about ten blocks, to cost probably $20,000. Next year we expect to continue the work and put in the system extending over the thickly built part of the city. The whole area embraced by Mr. Hering's plans will be about 4 sq. miles. Bids opened Aug. 5."

FREMONT, NEB.—Sewerage bonds for $45,000 have been sold.

PALESTINE, TEX.—Plans for a sewer system have been prepared and are being considered by the citizens.

LOS ANGELES, CAL.—The Council has voted to construct 8-in. sewers in seven streets and a 14-in. sewer in one street.

WINDSOR, N. S.—The plans of Prof. Butler for a combined system of sewerage for Point Nisbet have been adopted.

OTHER SEWERS.—The following places are discussing the question of a system of sewerage, and in some the plans have already been prepared: Calais, Me.; Camden, Me.; Hudson, Mass.; Charleroi, Pa.; Tarentum, Pa.; South Scranton, Pa.; Tucson, Ariz.

CRESTON, IA.—The City Clerk will receive bids until Aug. 17 for about 5,919 lin. ft. of 8 to 12-in. vitrified pipe sewers.

STREETS.

BROOKLYN, N. Y.—The Council has voted to repave four streets with asphalt. The Commissioner of City Works will receive bids until Aug. 17 for paving one street with cobble stones.

CORNING, N. Y.—The Council will receive bids until Aug. 15 for paving Pine St.

NEW YORK, N. Y.—The Commissioners of Public Works will receive bids until Aug. 16 for resurfacing the roadway of Sixth Ave. from 110th St. to 145th St. and until Aug 19 for paving two streets with asphalt or concrete, and five with granite blocks. The Park Commissioners will receive bids until Aug. 17 for 4,550 sq. yds. macadam pavement, 500 cu. yds. excavation, 1,200 cu. yds. filling, 520 lin. ft. 6-in. curb, 590 lin. ft. 14-in. edging, 8,400 sq. ft. concrete and cement pavement, 200 cu. yds. rubble stone masonry, 832 lin. ft. granite coping, etc.; also 832 lin. ft. wrought iron railing and gates constructed and erected.

NIAGARA FALLS, N. Y.—The City Clerk will receive bids until Aug. 15 for paving streets.

OLEAN, N. Y.—The Board of Public Works will receive bids until Aug. 23 for paving Union St. See advertisement.

ROCHESTER, N. Y.—The contract for paving Clinton St. with asphalt has been awarded to the Rock Asphalt Pavement Co., at $15,044. The estimate was $19,500.

TROY, N. Y.—The Board of Contract will receive bids until Aug. 19 for paving four streets with asphalt, and two with asphalt and granite blocks.

JERSEY CITY, N. J.—Bids for section 2 of the boulevard will be received until Aug. 18. This section extends from Twenty-second St. to the Morris Canal.

ALLEGHENY, PA.—Mayor Wm. M. Kennedy has issued a circular asking the opinion of business men and tax payers concerning the proposed issue of bonds for $600,000 for street improvements. It is claimed that of about 400 replies only 4 are opposed to the scheme.

BRADDOCK, PA.—The Borough Clerk will receive bids until Aug. 15 for paving six streets with vitrified brick on Allegheny River gravel. Bonds are to be issued for $100,000 for street improvements.

AUGUSTA, GA.—Broad St. between Jackson and McIntosh Sts. is to be paved with asphalt at an estimated cost of $20,000.

BOND HILL, O.—The Village Clerk will receive bids until Aug. 15 for the improvement of Carthage Ave.

COLUMBUS, O.—The Council has voted to pave several streets with asphalt, stone blocks, Hayden blocks, Hallwood blocks, Clayton blocks, brick, or limestone, and bonds will be issued to pay for the improvements.

PORTSMOUTH, O.—The City Clerk will receive bids until Aug. 16 for 16,028 sq. yds. brick or block paving, 7,817 lin. ft. straight curb, and 288 ft. circular corners.

TOLEDO, O.—The City Clerk will receive bids until Aug. 15 for improving nine streets and alleys and paving one with Medina stone, cedar blocks, vitrified brick, Trinidad asphalt on hydraulic cement concrete; also until Aug. 29 for paving two streets, as above.

YOUNGSTOWN, O.—Madison Ave., 9,534 sq. yds., is to be paved as soon as the property owners can decide which they prefer, asphalt or brick.

ELWOOD, IND.—H. S. Freeman, Cy. Engr., writes us that the city has under contract 17,000 yds. of brick paved streets, 7,000 ft. of macadam streets, 8,000 ft. of gravel streets, and 8 miles of 6-ft. brick sidewalk. The contract for bowldering 2,300 ft. of alley, and for 350 yards of masonry for the abutments of Buck Creek bridge will be let Aug. 15. The contract for 11 miles of board walk will be let Aug. 29.

INDIANAPOLIS, IND.—The City Engineer is preparing the necessary papers for paving Market and Meridian Sts. with asphalt to a width of 50 ft., thus making the approaches to the monument uniform with the Circle. The improvements will cost about $100,000.

CHIPPEWA FALLS, WIS.—The city has voted to pave several streets.

SPRINGFIELD, ILL.—The Council has passed ordinances for paving nine streets.

OMAHA, NEB.—The Board of Public Works will receive bids until Aug. 17 for paving five streets with asphalt, and until Aug. 19 for grading three streets.

PLATTSMOUTH, NEB.—The Council has ordered Sixth St. to be paved with brick, also ordered the City Engineer to hasten the plans for the sewer in Washington Ave.

OAKLAND, CAL.—The Council has passed ordinances authorizing the Board of Public Works to spend $149,500 for the construction of a public boulevard around Lake Merritt.

PORTLAND, ORE.—For paving Morrison St. with asphalt, the Trinidad Asphalt & Paving Co. bid $75,308 for Trinidad asphalt, and Bays & Jeffery, $55,399 for asphalt "equal to Trinidad asphalt."

SEATTLE, WASH.—The City Engineer reports that the proposed grading of Broadway and DeForrest St. will cost $25,577.

MONTREAL, QUE.—The City Surveyor estimates that it will cost $107,000 to repave Amherst St. Only part of the work will be done this year.

ELECTRICAL.

FORT FAIRFIELD, ME.—L. K. Cary informs us that a 500-light plant is being put in by private parties.

BOSTON, MASS.—The Mayor will receive bids until Aug. 15 for an electric light plant for Long Island.

GREENBUSH, N. Y.—The Village Trustees have awarded the contract for lighting the streets with electric lights for five years to the Albany Gaslight Co., at $4,500 per year.

ELKTON, MD.—The Elkton Electric Light Co. will receive bids until Sept. 5 for furnishing and placing ready for use an electric light plant, including poles, wiring lamps, boiler and boiler setting, steam pump and injector, automatic cut-off steam engine and connections to boiler and pumphouse. C. R. Maxwell, Secy.

MARSHFIELD, WIS.—An electric light plant is to be established in connection with the new water-works. There will be 100 arc and 1,500 incandescent lights. The works will be owned and operated by Moffett, Hodgkins & Clarke, Syracuse, N. Y., and W. H. Upham, Marshfield.

MINNEAPOLIS, MINN.—The Council has awarded a contract to the Brush Electric Co. for five years for 600 arc lights at $150 per light per year, each light to burn every night and all night. The city reserves the right to change on 30 days' notice from the all-night schedule to the moonlight schedule, at $125 per light per year.

KALISPELL, MONT.—Chester B. Davis, Consulting Engineer, Chicago, Ill., informs us that a lighting plant is being established. There will be 100 arc and 1,300 incandescent lights. For particulars address Mr. Davis

NEW COMPANIES.—Bellevue Light & Power Co., Bellevue, Pa.; $1,000; F. B. Fulsthwait, Wilkinsburg. Berwick Electric Light Co., Berwick, Pa.; $25,000; Treas., S. H. Watts. Spanish American Light & Power Co., Jersey City, N. J.; $4,000,000; W. S. Johnston, R. A. C. Smith, J. F. Gibbons, New York. Silver Plume Electric Light & Power Co., Georgetown, Colo.; $25,000. Hill City Street Railroad & Electricity Co., Vicksburg, Miss.; $100,000; G. P. H. Recter, Frederick Speed, H. C. McCabe. Ludlow Electric Light, Power & Manufacturing Co., Ludlow, Ky.; $100,000; J. G. Weaver, H. Boutet, E. A. Bradley.

CONTRACT PRICES.

STREET WORK.—Monongahela City, Pa.—We are informed by Albert Smith, Engr. in Charge, that the following contract has been awarded to R. T. Hallans & Sons, Washington, Pa.: Grading, 3,300 cu. yds., 32 cts. per cu. yd.; paving with vitrified brick on 8 ins. gravel and 2 ins. sand, pitched joints, 9,900 sq. yds., $1.30 per sq. yd.; curb, 5,900 lin. ft., 60 cts. per lin. ft. The bid for paving on 6 ins. broken stone, 2 ins. gravel, and 2 ins. sand was $1.82 for pitched joints and $1.67 for joints filled with sand, and that for 8 ins. gravel and 2 ins. sand, with pitched joints was $1.57. Other bids were from 25 to 40 cts. for grading, $1.35 to $1.90 for paving, and 60 to 90 cts. for new curb and 10 to 25 cts. for resetting old curb.

Asheville, N. C.—The bids recently opened ranged from 39 to 63 cts. per lin. ft. for curbing, 15 to 18 cts. per cu. yd. for earth excavation, 28 to 30 cts. for loose rock, and 70 and 80 cts. for solid rock.

Altoona, Pa.—The contract for paving Broad St. with asphalt has been awarded to the Barber Asphalt Paving Co., at $3 per sq. yd. for paving, 75 cts. per lin. ft. for new curb, and 10 cts. per lin. ft. for resetting old curb.

Chester, Pa.—Grading contracts have been awarded to Thos. Robinson, at 17 cts. per cu. yd.

Galveston, Tex.—Contracts have been awarded as follows: Orr & Co., grading, 19 cts.; paving with 6-in. creosoted wood blocks, $1.90, with 5-in. blocks, $1.74; brick curb, $16 per M.; A. H. McLean, sand for filling, 65 and 75 cts. per cu. yd.

Boston, Mass.—The contract for about 20,000 cu. yds. for filling has been awarded to Chas. McBride, at 57 cts. per cu. yd. Other bids were from 59 to 74½ cts. The bids for relaying edge stone, etc., ranged from 15 to 25 cts. per ft. for edge stones, and 21 to 62 cts. for gutters and sidewalks.

SEWERS.—Omaha, Neb.—A contract aggregating $15,891 has been awarded to F. L. Reeves & Co., at the following prices: 8-in. pipe, 65 cts. per lin. ft.; 10-in. 74 cts.; 12-in., 97 cts.; 15-in., $1.21; 18-in. $1.40; 21-in., $1.70; 24-in. $2.27; 28-in. brick sewer, $1.71; 30-in. $1.85; 32-in., $1.95; 36-in., $3.70; 40-in., $4.18; 42-in., $5.03; 48-in., $4.30; manholes, $40 each; flush tanks, $95.

Des Moines, Ia.—Bids have been opened as follows: 60-in. double ring brick sewer, $5.37 to $7 per lin. ft.; 48-in., $2.01 to $2.90; 36-in., $2.20 to $4.44; 21-in. pipe, $1.33 to $2; 15-in., $1.32 to $1.67.

Monongahela City, Pa.—Albert Smith, Engr. in Charge, sends us the following statement of the contract which has been awarded to F. C. Kohne, Pittsburg: 8-in., 3,125 ft., 58 cts.; 10-in., 2,835 ft., 68 cts.; 12-in., 2,005 ft., 78 cts.; 15-in., 230 ft., 86 cts.; 18-in., 1,220 ft., $1.30; 20-in., 1,000 ft., $1.50; 24-in., 580 ft., $2.10; 60, 180 and 120 ft. of 12, 20 and 24-in. iron pipe, $30 per ton laid; flush tanks, $60; inspection chambers, $30; manholes, $50; Dunlap manholes, including two storm inlets, $80.

SEWER PIPE.—Waltham, Mass.—The contract for 4-in. Akron pipe and connections has been awarded to G. F. Frost, at 75% discount from list price.

WATER-WORKS SUPPLIES.—Allentown, Pa.—The Water Board has awarded contracts as follows: Donaldson Iron Co., Emaus, Pa., 4-in., pipe, $25.50 per gross ton; 6-in., $24.50; specials, 2¾ cts. per lb.; F. Hersh & Son, pig lead. 4.68 cts. per lb.

Kalamazoo, Mich.—The lowest bid for about 119 tons of 10-in. pipe, 15 tons 8-in., 104 tons 6-in. and 4 tons of special castings, was that of the Addystone Pipe & Steel Co., Cincinnati, O., $23.94 per ton for pipe, and 2½ cts. per lb. for castings. The lowest bid for 6, 8 and 10-in. valves was that of Crane & Co., $10.25, $16.50 and $25, respectively.

EDGESTONES.—Boston, Mass.—The contract for 10,000 lin. ft. of edgestones has been awarded to J. E. Lambert, at 70 cts. per lin. ft.

DREDGING.—Albany, N. Y.—The following bids have been received for dredging in the Hudson River, near Troy: P. W. Myer, 10,000 cu. yds. below the upper bridge, 38½ cts.; 17,000 cu. yds. of the Washington Bar, 38½ cts.; E. M. Payne, 39⅞ and 38 8-9 cts.

MISCELLANEOUS.

DREDGING.—Washington, D. C.—Bids will be received until Aug. 20 for dredging at the Brooklyn navy yard. N. H. Farquhar, Chief of Bureau of Yards and Docks.

Philadelphia, Pa.—Bids will be received at the U. S. Engineer Office until Sept. 1 for dredging in the channel through Cherry Island Flats, Delaware River. Maj. C. W. Raymond.

GAS COMPANIES.—Berwick Gas Co., Berwick, Pa.; $25,000; Treas., B. F. Crispin, Jr. Central Vulcan Gas Co., Chicago, Ill.; $3,000,000; C. F. Griffin, W. J. Bell and E. T. Coman. American Gas Economizer Co., Chicago, Ill.; $100,000; J. P. Elliott, E. Sprague, E. T. Gardner.

GAS LIGHTING.—Minneapolis, Minn.—The Council has awarded a five years' contract to the Minneapolis Gas Co. for 4,000 lights at $26.69 per light per year, each light to burn every night and all night. The city retains the right to change on 30 days' notice from an all-night schedule to the moonlight schedule, at $15.63 per light.

DRAIN AND RETAINING WALL.—Boston, Mass.—The Board of Park Commissioners will receive bids until Aug. 22 for an outlet drain from Franklinfield, also for retaining walls at Charleston Heights.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Cooke Locomotive Works, Paterson, N. J., have built some ten-wheel engines for the Illinois Central, and two for the Everett & Monte Christo. The Brooks Locomotive Works, Dunkirk, N. Y., are building engines for the Cincinnati, Hamilton & Dayton, and have delivered a ten-wheel switch engine for the Cleveland Belt & Terminal. The Dickson Mfg. Co., Scranton, Pa., have an order for ten engines for the New York, Ontario & Western. The Baldwin Locomotive Works, Philadelphia, Pa., are building 1 ten-wheel and 1 eight-wheel, four-cylinder compound for the Chicago & Northwestern; also 4 consolidation four-cylinder compounds. The Richmond Locomotive Works, Richmond, Va., have an order for 4 consolidation engines for the Savannah, Americus & Montgomery.

CARS.—The Gilbert Car Mfg. Co., Troy, N. Y., is building cars for Australia and New Zealand. The Laconia Car Works, Laconia, N. H., have built 2 baggage and mail cars, and have an order for 12 passenger cars for the Maine Central. The Fitchburg will build 12 cars similar to 12 recently built to plans prepared by Mr. J. W. Marden, Superintendent of the Car Department. The National Trust & Construction Co., of Toronto, has been organized to manufacture passenger and freight cars, etc.; capital stock, $500,000; among the incorporators are Wm. Wainwright, of Montreal, Asst. Gen. Man. of the Grand Trunk Ry., and Mr. Barr, of Toronto, Canadian Manager of the General Electric Co.

THE NATIONAL SWITCH & SIGNAL CO., Easton, Pa., reports a considerable amount of work on hand, including the following: 72 levers, 43d St., Chicago, Illinois Central; 24 levers, 71st St., Chicago, Illinois Central; 48 levers, Fiddlers' Green Junction, Central of New Jersey; 16, Princeville, Ill., Atchison, Topeka & Santa Fe and Rock Island; 24, Springfield, Ill., Wabash; 40, Brooklyn, N. Y., Long Island; 12, Camp Douglas, Wis., and 12, Minnetonka, Chicago, Milwaukee & St. Paul; 16, La Paz, Ind., and 12, Welker, O., Baltimore & Ohio; 24, Mt. Vernon, O., Baltimore & Ohio and Cleveland, Akron & Columbus; 12, Thampson, Neb., Chicago, Rock Island & Pacific. All standards have been changed to conform to the Pennsylvania, and are used unless other kinds are specially called for. Mr. Geo. H. Pfeil is Chief Engineer.

ASPHALT WORKS.—The Compagnie Generale des Asphaltes de France has recently completed a large addition to its works in Long Island City, at a cost of about $175,000. Mr. T. H. Boorman is General Manager.

THE KING BRIDGE CO., Cleveland, O., has been awarded the contract for constructing a three-span bridge, including a swinging span, at Duluth, Minn. Mr. John Lundie, Western representative, Chicago, has had his territory increased to include the heavy work in Illinois and Wisconsin, and will also have charge of the Duluth work.

GEO. E. NYE, Chicago, manufacturer of the improved Nye steam vacuum pump, is doubling the capacity of his plant and putting in new machinery. He will establish branches in New York, St. Louis, St. Paul, Pittsburg, and Cleveland.

THE COLUMBIAN STEAM PUMP CO., Chicago, has succeeded the Nye Steam Vacuum Pump Co., and not the Ayer company as stated last week. The capacity of the Chicago pumping plant for which it has the contract is 12,000,000 gallons daily, instead of 3,000,000 gallons.

THE F. O. NORTON CEMENT CO., New York, has issued a list of some of the important bridges, buildings, dams and other work on which the Norton cement has been used.

THE THOMSON METER CO., New York, has declared a dividend of 1½% on its capital stock.

H. WARD LEONARD & CO., New York, report several contracts for complete electric lighting and power plants. The plant in the power station of the Broadway cable railway, New York, will comprise between 3,000 and 4,000 lamps, and a number of electric motors; slow speed dynamos, coupled directly upon the engine shaft, will be used. The Havemeyer Building, for offices, now being erected in New York, will have over 3,000 incandescent lamps; the wiring will be done in interior conduit throughout, and the generating plant will be the most modern type, the dynamos being directly coupled upon the shaft of the engine. In the Betz office building, Philadelphia, Pa., there will be 3,000 to 4,000 lamps, and the plant will be a modern one in every respect; Dr. W. A. Drysdale is the consulting mechanical engineer, and Mr. Alfred Wolff, of New York, the consulting engineer on the steam work; the plant is to have slow motion dynamos, directly coupled on the shaft of the engine.

NEW COMPANIES.—San Francisco Contract & Equipment Co., San Francisco, Cal.; $100,000; Wm. Montgomery, T. D. Haskins, and A. E. Shattuck. McLeod Railway Equipment Co., New York; $300,000; McLeod system of car heating; J. S. McLeod, E. E. Tullis and E. M. Fletcher. Southport Construction Co., Southport, N. C.; $25,000; H. H. Dougherty, W. H. Pyke, and Wm. Weeks. Nebraska Construction Co., Trenton, N. J.; $10,000; Henry Schauffer, C. O. Kruger and W. W. Laughlin.

CURRENT PRICES.

RAILS.—New York: $30 at Eastern mills, $30.75 at tidewater; old rails, $18 for iron and $13.50 for steel. Pittsburg: $30; old rails, $18 for iron and $15 to $16 for steel. Chicago: $31 to $32.50; old rails, $18 to $18.25 for iron and $12 to $13 for steel.

TRACK MATERIALS.—New York: steel angle bars, 1.6 to 1.65 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.5 to 2.6 cts. with square and 2.7 to 2.8 cts. with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.77 cts. for iron and 1.8 cts. for steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.75 to 1.8 cts. for iron and steel; spikes, 2.05 to 2.1 cts.; track bolts, 2.65 to 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57¼ and 47½ per cent. on black and galvanized butt-welded; 67½ and 55 per cent. on black and galvanized lap-welded. Casing 55 per cent.

FOUNDRY PIG IRON.—New York: $13.50 to $15.50. Pittsburg: $13.25 to $14.50; Chicago: $13.50 to $15.

LEAD.—New York: 4.1 to 4.15 cts. Chicago: 4 cts. St. Louis: 3.5 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.2 to 2.5 cts. for large lots, and 2.4 to 2.75 cts. for small lots, channels, 2.25 to 2.5 cts.; angles, 1.85 to 2 cts.; tees, 2.3 to 2.75 cts.; sheared iron plates, 1.9 to 2.25 cts.; steel plates; 1.85 to 1.9 cts. for tank, 2 to 2.25 cts. for shell, 2.5 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 1.9 to 1.95 cts. for large lots, and 2 to 2.05 cts. for small lots; channels, 1.9 to 1.95 for large lots, and 2 to 2.05 cts. for small lots; angles, 1.8 to 1.9 cts.; tees, 2.35 cts.; universal mill plates, 1.75 to 1.8 cts. for iron and 1.8 to 1.9 cts. for steel; sheared steel bridge plates, 1.95 to 2.05 cts.; refined bars, 1.7 to 1.75 cts. for iron and steel; steel plates, 1.75 to 1.85 cts. for tank, 2 to 2.1 cts. for shell, 2 to 2.1 cts. for flange, 3.5 to 3.75 cts. for firebox. Chicago: beams, 2.3 to 2.35 cts. for large lots, and 2.5 cts. for small lots; channels, 2.15 to 2.25 cts.; angles, 2.2 to 2.25 cts.; tees, 2.4 to 2.6 cts.; universal plates, 1.9 cts.; sheared steel plates, 2.3 to 2.4; steel plates, 2.3 to 2.4 cts. for tank, 2.3 cts. for shell, 2.9 to 3 cts. for flange.

VILLAGE OF HARLEM.

PROPOSALS FOR WATER-WORKS.

Sealed proposals will be received by the President and Board of Trustees of the Village of Harlem, Cook Co., Ill., until 12 o'clock of the 27th day of August, A. D., 1892, for furnishing all the materials and constructing in said Village the Pump and Boiler House, with Chimney, the Special Water Tower and the Storage Reservoir, all completed in accordance with plans and specifications for the same on file in the office of the Village Clerk on and after the 28th day of July, A. D., 1892.

Each and every proposal will be accompanied with a certified check for the sum of $250, payable to the Village Treasurer of Harlem, as a guarantee of good faith, said check to be returned to the bidder making it when his proposal has been rejected, or when accepted and a satisfactory bond deposited with the President and Board of Trustees of the Village of Harlem.

Proposals will be received for the above work as a whole, and not for separate parts thereof, and must be strictly in accordance with the said plans and specifications, or they will not be considered.

Each and every proposal must be marked "Proposals for Pump House, with Chimney, the Special Water Tower and the Storage Reservoir," and must be filed with the Village Clerk of Harlem, Cook Co., Ill., on or before the time stated above.

The right is reserved to make any changes in the above work, to the amount of fifteen per cent. of the same, at proportionate prices, before the materials have been furnished; and the right is still further reserved to reject any and all proposals.

GEORGE SCHRADE,
Village Clerk.

Harlem, Cook Co., Ill., July 28, 1892. 33-1t